



ATW

TECHNICAL DOCUMENTATION



THE ATARI TRANSPUTER WORKSTATION.

MODEL 4.3 SPECIFICATION

INTRODUCTION

The Atari Transputer Workstation offers extremely high computing & 3D graphics performance, with purpose designed multi-processor architecture.

The architecture, custom graphics co-processor and sheer number-crunching performance offer the most cost-effective, high resolution graphics and computing performance available today.

No other processor architecture builds on and protects capital equipment investments better than those based around the Transputer. All other computer architectures are based on built-in system obsolescence, whereas Transputer based machines with their expansion capabilities get bigger and more powerful.

MEMORY

The ATW Model 4.3 starts with three processors : a T800 Transputer, (32 bit integer/64 bit floating point), a 32 bit Graphics/Raster-Op co-processor and a 16 bit I/O processor, with a total distributed on-board memory of 6 megabytes, as summarised below:

Node/Processor	Base Memory
T800, (Graphics)	4 Mbytes DRAM.
Blossom Raster-Op co-processor	1 Mbytes VRAM.
68000, (I/O)	1 Mbytes DRAM.

The Graphics node DRAM may be increased in 4 or 16 Megabyte increments to a total of 64 megabytes using an optional DRAM expansion board.

Additional processor nodes begin with upwards of one megabyte of DRAM or as little as 32K of SRAM.

VIDEO

Four basic video modes are provided and supported. The video modes are completely user-programmable via the Raster-Op co-processor 'Blossom'.



	Resolution	BPP	Colours	Palette
MODE 0	1280 x 960	4	Mono 16 grey levels.	
MODE 1	1024 x 768	8	256	16 Million.
MODE 2	640 x 480	8	256	16 Million.
MODE 3	512 x 480	32	True Colour.	
MODE 4	1280 x 960	4	16	4096

	Pixel Rate		Line Rate	
MODE 0	107.5	MHz	65.0	KHz (Grey Scale)
MODE 1	64.0	MHz	50.0	KHz
MODE 2	26.87	MHz	31.5	KHz
MODE 3	25.0	MHz	1.5	KHz
MODE 4	107.5	MHz	65.0	KHz

(NOTE MODE 0 IS AVAILABLE BUT NOT SUPPORTED BY ATARI FOR USES OTHER THAN NON-INTERACTIVE DISPLAYS. IT IS NOT RECOMMENDED AS A MODE FOR INTERACTIVE EDITING).

ATARI RASTER-OP CO-PROCESSOR: 'BLOSSOM'

Blossom gives the ATW extremely high performance graphics capability, performing line draw, trapezium fill, block or stipple fill with bit planar or linear functions of source, destination and mask areas. The tiled mask allows fast font rendering whilst the sideways access to video RAM can plot stipple patterns at rates equivalent to that of three to five T800's. Some operations run at speeds that are 8-16 times faster than a Transputer can achieve.

The variety of functions coupled with an optimised software interface provide a graphics sub-system to rival dedicated graphics computers. The reason Blossom can achieve such performance is that the entire memory controller, arbitration and graphics control are implemented on one chip.

Functions designed specifically with X in mind:

- * 32x32 pixel mask.
- * 16 bit wide functions on source and destination.
- * 4 linear comparisons on each pixel per cycle.
- * Square area fill up to 128 Megapixels/second.
- * Line drawing at up to 32 Mpixels/second.
- * Trapezoid fill at up to 32 Mpixels/s
- * The performance figures differ according to the chosen screen resolution, and not all of these functions are used in the X server.



I/O

The following electrical interfaces are provided:

- * ECL/TTL Buffered Inmos Links.
- * Centronics.
- * RS232.
- * Midi interface.
- * Floppy disk.
- * Mouse.
- * ACSI port, (for connection to such peripherals as the Atari Laser printer).
- * SCSI.
- * ST video, which may be used for terminal output, such as diagnostic data, or normal ST operation.

PROCESSOR AND I/O EXPANSION

Processing and peripheral device expansion is provided by means of internal expansion slots supporting multiple Tram motherboards for the Industry Standard Inmos Tram compatible cards, 'Farm Cards', and specific non link connected bus designed peripherals, such as additional memory.

With optional Atari Tram motherboards installed, up to 36 additional processors may be installed in the system. (Actual number is limited by power usage of the additional trams and their physical format).

ATW PROCESSOR EXPANSION & CONTROL

Unusually for Transputer based systems, all Transputers, even of third party trams are separately addressable on the diagnostic bus.

Atari Tram Motherboard

Tram12, a motherboard which plugs into the expansion slots of the ATW workstation. It has slots for twelve Tram's (Trams are board level Transputers that integrate processor, memory and peripheral functions, and which communicate with the outside world by means of INMOS serial links, arranged in a standard pin-out). Links 1 and 2 from each of the Tram slots are hard wired, such that the Tram's when plugged in, form a pipeline of processing elements. The remaining links can be "softwired" using an INMOS C004 programmable link switch, incorporated on the Tram12. This arrangement allows a large variety of networks to be created under software control.

The INMOS C004 is controlled by the Diagnostics Bus. Configuration data is directed either into the C004's configuration link or into the C004's link0 under control of the Diagnostics Bus. Configuration data is then passed out of the C004 on link31. In this way configuration data is passed down the chain.



Features:

- * Twelve Tram sites per board.
- * Isolated diagnostics bus.
- * Reset/Analyse for each Tram site.
- * Separate configuration data link.
- * C004 Configurable network (for twelve on-board Tram sites).
- * Links 1 and 2 of each slot hard wired into a pipeline.

The Diagnostics Bus

The ATW workstation uses a proprietary scheme. The Diagnostic Bus allows individual network nodes to be reset and/or - in the case of Immos Transputers - analysed. To this end, each network node has two control signals associated with it.

The electronics providing the control signals for each node are connected as a daisy chain and information passes down that chain serially i.e. the node controllers are connected as a distributed shift register, this register may be extended reliably to many hundreds of nodes.

The control for this bus originates from a server node, which is normally the 68000 I/O server. Tram12 provides the facility for this server to be a Tram inserted into site one. It is also possible for the Tram in site one to drive the Configuration Link assuming it has the relevant circuitry.

STORAGE CAPACITY

The SCSI bus is used, providing the user with access to industry standard and state-of-the art SCSI devices such as disk drives, CD based devices and many others. 40-770 MB drives are available and 16 partitions of up to 1 Gigabyte each are supported.

The ATW is unusual in that low cost optional removable media hard disk drives may be used. Alternatively fixed disk drives can be obtained with capacities as required; fixed 44 Megabytes is standard of which Helios occupies approximately 3 Megabytes - this is achieved by extensive use of shared libraries. The removable media drive provides the user with many benefits, such as security of data & very convenient transport of applications between sites, backup and archive facilities. The media is low cost, conforms to a 10mm x 5.25" form factor and cartridges are also light weight at 200 grams (7 ounces).

THIRD PARTY HARDWARE PRODUCTS

There are very many different third party Tram modules offering such 'off the shelf' upgrades as Frame Stores, IEEE, Specialist Graphics DSP and Vector Processing. Several i860 Trams are available, complete with either an on-board Transputer or link adapters to handle comms. High density Trams are available which fit a 30 MIP



T800 complete with 4 Mbytes DRAM on a size one tram, (PCB half the size of a credit card, approx 1"x 3.25"/25mm x 85mm).

LANGUAGES

All the standard programming languages with debuggers are available, such as ADA, occam, ANSI C, C++ , Fortran 77, Pascal, Modula-2, Basic and modern languages. Parallel processing languages such as Strand, Transputer Assembler and a Macro Assembler are also available. A high level of good software exists in the public domain, including languages such as Xlisp etc.

Some languages are effectively supported as cross compilers using Inmos's lserver: this means that the server runs on one processor and the compiler must run on a Transputer node which is not running the Helios kernel. The lserver may be run as a Helios task, or without Helios as a single process on the 68000 giving particularly fast lserver performance.

LIBRARIES

Many libraries are available, eg. GKS, and 3D support for rendering and animation. X windows, Posix and BSD libraries are supplied as standard with the Helios operating system.

STANDARD SOFTWARE PACKAGE (ATWDB24002)

Operating System

Helios is a fully distributed multiprocessor form of Unix and is essentially IEEE POSIX compliant. Of its more significant features is the extension to the C Shell Script Language: the Component Distribution Language (CDL), which is compatible with the C Shell syntax. This allows the programmer to describe the coarse grain parallelism of distributed programs with the ease of writing a Shell Script. The Task Force Manager then takes the defined processes and distributes them amongst free processors unlike Unix where the processes would be time sliced on a single CPU. The CDL has in part evolved from the denotational semantics of CAR Hoare's Communicating Sequential Processes (Published by Prentice-Hall) and the placement system of occam.

Helios, unlike Unix, requires approximately 3 megabytes of hard disk space - it achieves this by extensive use of shared libraries, and this is also reflected in Helios's efficient use of main memory.

Filing System

The disc organisation is based on that of the Berkley Fast File System of BSD 4.2 and later. Extensions to implement the Helios protection mechanisms and improve performance have been made. Cache, read-ahead and write-behind techniques are used to provide high transfer rates for disk to processor, inter-processor and interprocess transfers. Multi-threading within the server allows multiple concurrent



access by many clients. BSD/ARPA, TCP/IP and utilities are included as standard (additional Ethernet hardware required), whilst TAR (Tape Archive) is supported on the SCSI bus.

Tools & Other Facilities

Compilers:

Ansi compatible C, with source level debugger, X windows 11 toolkit and Transputer Assembler are supplied.

Iserver support:

Inmos server support means that direct access to raw Transputers is also available via the TDS and occam. The Iserver may be run as a Helios task or may be run more directly on the I/O server's 68000, allowing the developer access to more finely grained parallelism than that provided through Helios. The Iserver supports use of the new H1 development tools such as TDS 3.

User Interface

MIT's X Windows Version 11R4 is supplied and currently co-processor support is available for X11R2. Motif will shortly be available through a number of third party sources, and is not included.

SYSTEM PRICE, COMPLETE WITH SOFTWARE PACKAGE: £5,000

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EXCITING FUTURE DEVELOPMENT

'Inmos H1 Super Transputer'

- * 'H1' is the codename for the next generation Transputer.
- * Greatly improved performance combined with continued ease of use:
In excess of 150 Mips (peak) and 20 MFlops (peak).
- * Major additional support for multiprocessing:
Total bi-directional bandwidth of 80 MBytes/s.
On-chip virtual channel processor.
Off chip message routing.
- * Enhanced process model: support for real time kernels and operating systems.
- * Binary compatibility with present Transputer family.
- * Peripheral devices: link adapter, link converter, dynamic through routing switch.

Inmos is a member of the SGS-Thomson Microelectronics Group of Companies.