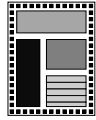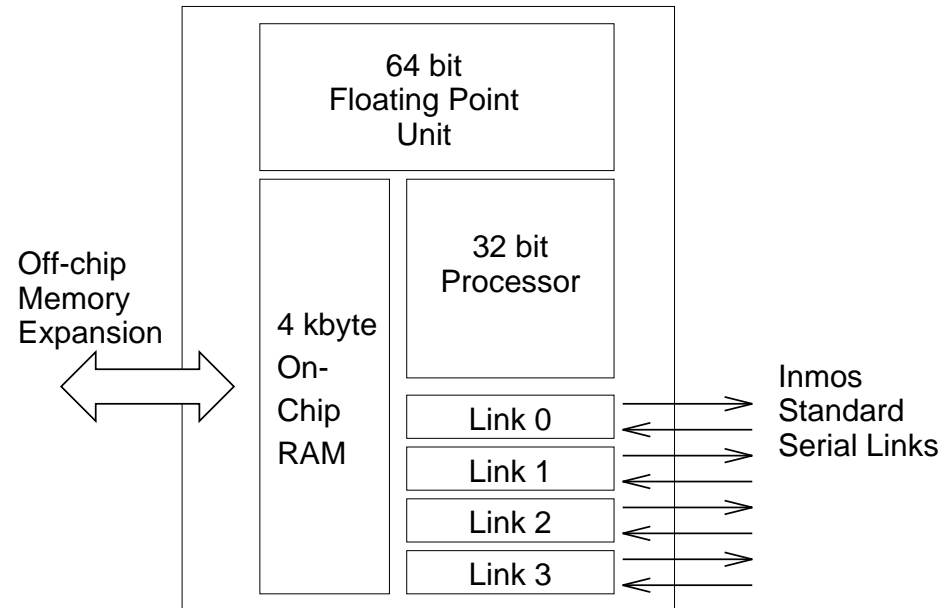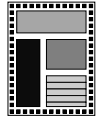# The INMOS Transputer - (SGS-Thompson)

- A Single Chip Microprocessor:
  - CPU
  - RAM
  - I/O

- A Building Block For Parallel Processors:
  - *Virtual Concurrency*
  - *Message Passing*
 - *Occam Engine*

Transputer Structure

- T800 Transputer:

    - 32 bit CPU

    - 4 kbytes On-chip RAM

    - 4 INMOS Serial Links.

    - 64 bit Floating Point Unit

13002

The Transputer

A Single Chip Microprocessor

- Designed for embedded processing and parallel computing.

- Minimum overheads for support circuitry.
    - Minimum requirement is:
        Transputer + Power supply + 5 MHz Clock.
    - *42 Transputers on 9″ by 9″ PCB.*

- Memory interface makes for easy connection to external RAM (if present).

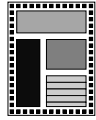- External ROM is seldom required except in standalone configurations.
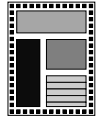
The Transputer

Support for Virtual Concurrency

Microcoded Scheduler

- Faster & Simpler than scheduler in software kernel.

- Minimum of Internal Registers (for rapid context switch)

  - Three Register Stack :   A B C
  - Workspace Pointer, Instruction Pointer & Operand Register.

- Scheduler cycles through a Linked List of Active Processes

  - Each process is executed for two ticks of the 1ms scheduling timer.
  - A process is descheduled at a suitable point
    — leaving stack and operand register empty.
  - Descheduled process is placed at back of list.
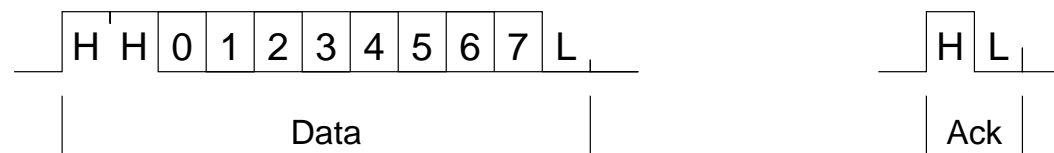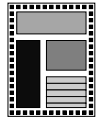 - Process from front of list is executed.

Message Passing — Links

- T800 has 4 INMOS Serial Links
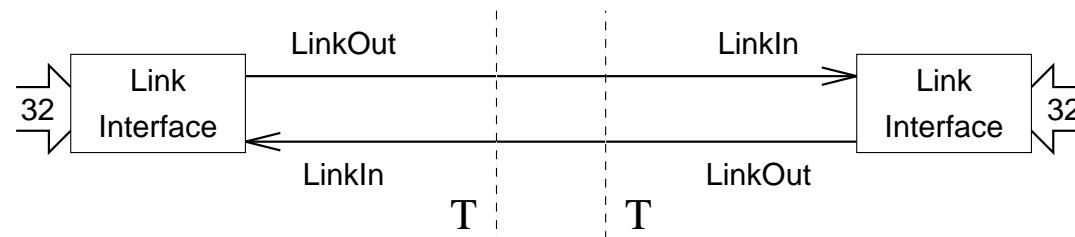
- Links are bit serial and asynchronous.

- Links are bi-directional supporting:

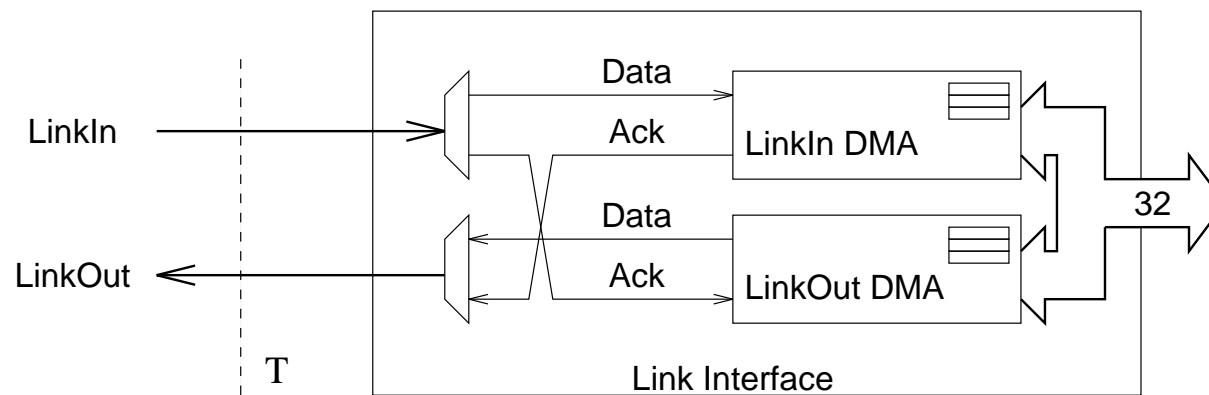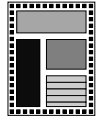   – LinkIn channel & LinkOut channel.

- All transfers are acknowledged.

13005

The Transputer

Message Passing — Links

- Data and Ack are multiplexed onto a single line.

- Link performance

  - Autonomous DMA allows concurrent use of all 8 channels.

  - Link speed is selectable – 5MHz 10MHz 20MHz (for T800).

  - Overlapping Data and Ack allows bi-directional transfer rate of 2.4 Mbytes/sec on each link (uni-directional transfer at 1.8 Mbytes/sec).

Support for Virtual Concurrency

Channel Communication

The same instructions, `in` and `out`, are used to provide occam style synchronized communication for both internal and external transfers. The channel number differentiates between hard and soft channels:

- Hard Channels (numbers 0–8)

    – between concurrent processes on different transputers.

    – the transfer of Ack tokens ensures inter-process synchronization.

- Soft Channels (numbers 9–)

    – between *virtually concurrent* processes on the same transputer.

    – the first process to access a channel is descheduled until the transfer is completed by the second process to ensure inter-process synchronization.
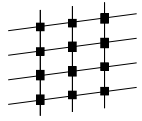
Networks

- Transputer has a fixed *valency* of 4.

- Hence the choice of networks is limited.
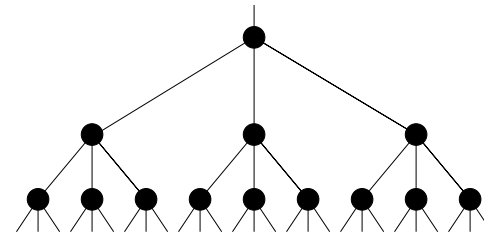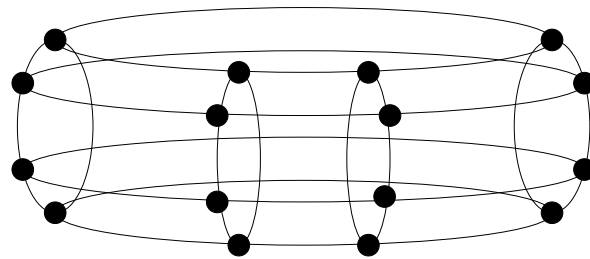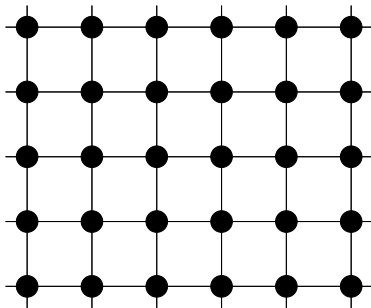
N.B. Given that Software Packet Routing is relatively expensive in Transputer networks and manual rewiring is not a serious option, many general purpose machines have been built using C004 Programmable Link Switches to provide limited network reconfiguration.

13008