Version 2, November 2011 **E6X4**

Programming and software for the Elliott 4100 Series computers.

Assemblers

There were two families of Assemblers, namely NEAT (National Elliott Assembly Technique) and SAP (Symbolic Assembly Programming language). These had variants and sub-sections, for example:

Basic NEAT Assemblers:	NEAT, NEATOUT, NEATC, NEATCOUT.
Commercial NEAT Assembler:	NEATCC.

High Level Languages

ALGOL (4100 Algol 60)
FORTRAN (4100 Fortran 66)
COBOL

Operating Systems

There was originally an intention to provide hardware assistance for multiprogramming. The 4130 was intended to offer two programming environments: *Executive Mode* and *Protected Mode.* Under the latter, which was to be the normal user mode when the multiprogramming system was in operation, a program was restricted to its allocated area of memory and was limited in its use of peripheral devices. An *Alarm Clock* was to be provided that set a limit on the time for which a particular user program could run within Protected Mode before being terminated. Within Protected Mode, core store was to be allocated to a user program via two 10-bit registers that gave the *Base* address and the *Range* of permitted memory. Any attempt to access a location outside the permitted area would cause the user's program to be suspended and Executive Mode entered.

To facilitate the above proposed multiprogramming environment, several additional Elliott 4130 instructions were suggested, including:

EXEN	enter Executive Mode
PMEN	load the Base and Range registers and the Alarm Clock setting and then enter Protected Mode.

It is believed that the above multiprogramming facilities were seldom activated for the Elliott 4130 computer, except in the KOS operating system described below. An *Alarm Clock*, actually known as the *Real Time Clock*, was, however, provided as standard for the 4130 and as part of the Autonomous Transfer Unit for the 4120. This produced an interrupt once every second and could be set to 'ring' by transferring data after N seconds.

An early in-house Elliott 4100 operating system used on the commissioning floor at Borehamwood was called SysD (System D). This offered a very simple system for loading and running paper tape based programs.

It is believed that the default end-user operating system for Elliott 4100 computers in the initial period from 1965 to 1968 was the Systems Executive known as EASE. This consisted of three sections: NICE (Normal Input and Control Executive), SPAN (Storage Planning and Allocation) and TSS (Time Sharing Supervisor). It is believed that the three sections of EASE constituted independent modules, as follows.

NICE was a simple Executive that enabled an operator to input relocateable binary paper tapes, enter a named program, remove a program, cause a print-out of an area of memory, etc.

SPAN handled the housekeeping for information transfers between primary memory (core) and secondary memory (eg disc pack). It assumed that a program's storage space was divided into *chapters*, each containing one or more *blocks*, each block containing one or more entry-points known as *labels.* A program may call upon one or more of SPAN's routines, which include the following utilities:

ALLOC	asks SPAN to reserve space (in primary memory) for a chapter. This may result in the response *No Room* if SPAN cannot find sufficient space.
DELETE	frees up space no longer needed by a chapter.
BANISH	move a chapter to secondary storage.
RECALL	bring a chapter into primary storage.

TSS was available to look after *Interrupts* and *Attentions* coming from each Standard Interface channel, transferring control to a routine appropriate for each peripheral device. The Elliott 4100 series defines three levels of program priority, the highest being called the Interrupt level, the intermediate one being called the Attention level and the lowest level being that of normal computation. There exist appropriate TSS routines running at each level. Transfers to/from a level within TSS occur either as a result of an Interrupt or Attention signal or as a result of subroutine entry/exit. TSS organises queues and buffers as appropriate, for input/output transfers.

By the 1970s, it is thought that several other operating systems had been implemented for Elliott 4100 series computers. **DES** (Disc Executive System) was a standalone operating system used by individual large users, for example when working overnight and at weekends. It allowed programs to access the whole of physical memory. **DES2** had a 'slave' area of memory where a second program could be run in tandem with the first program. **DES BATCH** was the batch job operating system, used for example in computing service environments. It is believed that another system, called **T30C**, could also be used in batch mode.

Elliott 4100 series computers were installed at several UK Universities, where they inspired systems software developments by the academic users. The University of Kent at Canterbury was especially active, being responsible for the Kent On-line System KOS, a simple multi-access operating system which allowed both batch use and on-line terminals simultaneously. KOS, implemented on an Elliott 4130 in the period late 1968 to early 1970, supported a fully-conversational incremental BASIC compiler via eight teletype terminals. The development of the BASIC compiler was a joint venture between Kent and the University College of North Wales.

Another, unrelated, on-line multi-access system had come live in 1967 when the functional language POP-2 and Multi-POP was implemented on an Elliott 4120 at the Department of Machine Intelligence and Perception at Edinburgh University.