12 Memory allocation and usage

Two fundamental points have been stressed in various parts of this book.

The first is that programs should only use memory allocated for their general use or memory designated for specific functions when requiring or performing that function.

The second point is that software should not make assumptions about its environment, The amount of user RAM available depends on the screen MODE selected and the amount of workspace RAM claimed by paged ROMs.

The Electron microcomputer's memory map:

&FFFF	Operating system ROM
&FF00 &FEFF	Memory mapped I/O
&FC00 &FBFF	Operating system ROM
&C000 &BFFF	Paged ROM space
&8000 &7FFF	Screen memory
HIMEM	
OSHWM	Paged ROM workspace/exploded font
&E00	

&DFF	NMI routine and paged ROM information (WARNING, not for user programs)
&D00	
&CFF	Operating system private workspace
&A00	
&9FF	Sound system workspace/OS workspace
&800	
&7FF	Current language private workspace
&400	
&3FF	Operating system private workspace
&236	
&235	OS call indirection vectors
&200	
&1FF	6502 stack
&100	
&FF	Zero page
&00	

Zero page

Zero page Zero page locations are very valuable due to the necessity of their use with certain types of indexed addressing. In absolute terms there are no allocations to the user as such. However the current language should re-allocate some of its zero page to the user if appropriate. Should the user be executing machine code independently of any language the language's zero page allocation is totally available.

&00 Current language

&8F
&90 Econet zero page

&9F
&A0 Current NMI owner

&A7
&A8 Utility workspace

&AF
&B0 Filing system transient zero page

&BF
&C0 Filing system exclusive zero page

&CF
&D0 OS reserved workspace

&FF

Current language zero page **&00 to &8F**

The currently selected language has exclusive use of these locations. BASIC re-allocates &70 to &8F for user's assembly language routines.

Econet zero page **&90 to &9F**

These locations are allocated for the exclusive use of the Econet filing system if fitted. If software is produced which is designed to run only on those machines not having the Econet upgrade then these locations may be used but only after confirming that Econet is not present.

Current NMI owner zero page **&A0 to &A7**

These locations are allocated to the current owner of the NMI. This will normally be the Disc or Econet filing systems. Paged ROM service calls are issued to claim and release the ownership of the NMI (see section 10.1).

Utility workspace zero page **&A8 to &AF**

This memory is allocated for use by the code executed via the command line interpreter, It is used by the operating system for its own *commands. It may also be used by paged ROM and file based utilities when invoked by the ‘unknown *command’ mechanism (see sections 10.1 (paged ROMs) and 5.7 (OSFSCV))

Filing system transient zero page **&B0 to &BF**

These locations are allocated for use by the currently selected filing system but they may be corrupted by other software between filing system calls.

Filing system exclusive zero page **&C0 to &CF**

This memory is reserved for the exclusive use of the currently selected filing system. This memory should not be used by the filing system’s NMI routine.

Operating sytem reserved workspace **&D0 to &FF**

This region of zero page memory is exclusively reserved for operating system use. Within this area there are a number of locations in which the operating system stores information which will be of use for certain routines.

&EE – 1MHz bus page number

&EF – This location contains the accumulator value passed with the most recent OSBYTE or OS WORD call.

&F0 – This location contains the X register value passed with the most recent OSBYTE or OSWORD call.

&F1 – This location contains the Y register value passed with the most recent OSBYTE or OSWORD call.

&F2 and &F3 – These locations contain an address which points to the text offered to the command line interpreter.

&F4 – This location contains the ROM number of the currently active paged ROM. (The operating system maintains this as a RAM copy of the paged ROM selection latch.)

&F5 to &F7 – These locations are used for the *ROM filing system (see chapter 11).

&FA to &FC – These locations are available for use by routines which have set the interrupt flag. The operating system interrupt routines use these locations but do not expect the contents to remain unchanged between calls.

&FD and &FE – These locations are written to after a BRK instruction has been executed. They contain the address of the next byte of memory following the BRK instruction. Thus these locations normally point to an error message (see section 6.2). Upon selection of a language these locations are set to point at the version string of the newly selected language ROM.

&FF – This location contains the ESCAPE flag. Bit 7 of this location is set to mark an ESCAPE condition. This flag is cleared when an ESCAPE is serviced.

Page 1

This page is used for the 6502 stack. The stack grows from the last byte in this page (&1FF) down towards the bottom of the page. Paged ROM service routines may use the bottom of this page to store error messages.

Page 2

The operating system routines' indirection vectors are located from &200 to &235. The rest of this page is used as private operating system workspace. The way in which private operating system workspace is used may change between different software versions and different machines in the Acorn BBC range.

Page 3

This page is designated private operating system workspace and should not be used by any other software. The BBC microcomputer and the Electron operating systems use this page for the VDU routines' workspace, some miscellaneous tape filing system workspace and for the keyboard buffer.

Pages 4, 5, 6 and 7

These four pages are allocated for the exclusive use of the currently selected language. Should a user be executing code independently of a language this memory may be used by that code. The user's code should not re-enter a language without ensuring that the language has had an opportunity to reset its workspace.

Page 8

This page is allocated for the sound system and for buffers:

&800 to &83F	general sound workspace
&840 to &84F	sound channel 0 buffer
&850 to &85F	sound channel 1 buffer
&860 to &86F	sound channel 2 buffer
&870 to &87F	sound channel 3 buffer
&880 to &8BF	printer buffer
&8C0 to &8FF	envelope storage area (env.no's 1 – 4)

On the Electron this area is available for the implementation of external sound and the printer buffer area is used by the Plus 1 expansion software. Locations in this page should only be used by system software performing the appropriate task e.g. user printer routines, sound expansion routines.

Page 9

This page is used as workspace for the sound system and the serial system (tape and RS423). Theoretically clashes of use could occur but in practice problems very rarely arise. The

operating system uses this area for RS423 and tape output buffers but the area is also allocated for speech and sound use. Thus externally implemented systems performing these functions may utilise this memory according to the allocation below.

&900 to &9BF	envelope storage area (env.no's 5 – 16)
&9C0 to &9FF	speech buffer

Pages &A to &C

These pages are reserved for exclusive use of the operating system as private workspace. The nature of the operating system use cannot be relied upon between different software versions and between different machines in the Acorn BBC range.

Page &D

This page is allocated in the following way:

&D00 to &D5F	NMI routine
&D60 to &D9E	reserved
&D9F to &DEF	paged ROM extended vectors
&DFO to &DFF	paged ROM workspace table

The NML routine is the code which is executed when a non-maskable interrupt is generated. This is entered at &D00 and should service the interrupt.

The paged ROM extended vectors provide an entry into paged ROM code regardless of which ROM is active as the call is made. See section 10.3 for a description of extended vectors.

The paged ROM workspace table contains a single byte page address indicating the start of each ROM's private workspace (see section 10.3 for further details).

WARNING

Many games programmers have used page &D. These games will not work when a Plus 1 is fitted because it uses this space. DO NOT continually disconnect and re-connect the Plus 1 because this will damage both the Plus 1 and the Electron, A suitable program which disables the Plus 1 can be obtained from Acorn Computers Limited.

Page &E00 to the OSHWM

This memory is available for paged ROM workspace and for character definitions as part of a user defined font.

Each ROM is interrogated during a reset to determine its workspace requirements (see paged ROM service calls, section 10.1). This workspace extends from &E00 in page sized units until all the paged ROMs have made their claims.

The Acorn BBC range of machines allow the user to define the character patterns that are printed on the screen. The number of user defined characters which may be used depends on the explosion state of the font (see OSBYTE & 14). On the Electron and BBC microcomputer the memory required when exploding the font is allocated above the paged ROM workspace.

The user (or language) memory starts from the top of this workspace memory and the start address of this memory is called the operating system high water mark (OSHWM).

OSHWM to HIMEM

This is where a user might expect his program to live. Theoretically this memory has no fixed start address and no fixed end address which taken to extremes means that it may theoretically have no size. In practice, on the BBC microcomputer and the Electron, the region from &2800 to &3000 can be assumed to be within the OSHWM/HIMEM bounds.

The language environment may also place constraints on the amount of RAM available for a user's program and/or data.

No RAM should be accessed above HIMEM. This includes the screen memory and, on a second processor, the memory in which the language is stored.

Screen memory

This memory is not guaranteed to exist at any given place on Acorn BBC range machines, For example when a Tube is active a program may find itself on the second processor and thus any attempts to access what was the screen memory will have no effects on the screen image.

For more information about programming practices read chapter 1 on the Acorn design philosophy and programming rules.

Paged ROM memory: &8000 to &BFFF

This region in the memory map of non-Tube machines or I/O processors contains the currently 'paged' paged ROM. When the current filing system is in paged ROM and a filing system function used then the appropriate paged ROM is selected.

Operating system ROM memory: &C000 to &FFFF

The contents of the OS ROM are undefined except for the OS call entry points described in chapter x and the default vector table described in section 6.11.

Memory mapped IO: &FC00 to &FEFF

Hardware devices are addressed via these memory locations. Once again extreme care should be taken to address them in the correct manner using OSBYTEs &92 to &97 for reading and writing these addresses. See chapter X for more information about the memory mapped I/O.

(The OS ROM contains a list of credits in this region made inaccessible by the switch to memory mapped I/O.)