

# The Register

Martin Brennan joined Sinclair Research in 1982 specifically to investigate and develop new artificial intelligence algorithms, but he soon became wrapped up in broader efforts centred on bringing [Sinclair's promised Microdrives](#) to market. Brennan eventually engineered the ZX Interface 1 through which the Microdrives would connect to the Spectrum.

But Sinclair Research wasn't the kind of place where engineers were told to work on specific projects to the exclusion of all else. The company hired young, brainy people and gave them space for their natural creativity to flourish.

One of Martin's ideas: a really cheap machine that could bring punters in through its gaming capabilities but provide scope for expansion so they might build it up into a full computer in due course. Designed to be inexpensive, it would perhaps replace the monochrome ZX81 and certainly protect the Spectrum from Far Eastern rivals feared to be on a mission to undercut Britain's market leader.

There was a template for such an expandable system: the Mattel Intellivision. Launched in America in 1979 but not made available in the UK until 1982, the Intellivision had been developed as a games console to rival Atari's massively popular VCS 2600. Unlike the Atari box, the Intellivision was created with the idea that its console hub could, with the addition of a bionic keyboard add-on, become a true personal computer.

The Intellivision Keyboard Component, as the add-on was called, provided extra memory, a cassette interface and a 6502 processor. Essentially it was a computer in its own right, using the console as a TV-output peripheral. It proved hard to engineer, and was late to market.

LC3 would avoid these problems by starting out as a computer. **The notion was to fit it with a Z80 processor, a little bit of memory and enough ROM for the operating system, which would load games in off ROM cartridges.** It was envisaged as **a small black box with a ROM slot in the front**, says Stephen Berry, the Sinclair software engineer Martin Brennan got working on the LC3's OS and Basic interpreter while he worked up a prototype motherboard. It's not hard to imagine the visual inspiration: the ZX Microdrive itself.

Not that LC3 ever got as far as an industrial design. Breadboards were built with TTL to provide Berry with hardware on which to run his code, but the project doesn't appear to have progressed any further than that. Berry says he was shifted to more pressing matters: wrangling the documentation for the QL, for one, a task that took him many months of full days and weekends of work to complete.

There was no time for the LC3 until all that was done, and by the time the QL manuals had been completed, around June or July of 1984, the LC3's time had passed.

"I wasn't at Sinclair for the LC3 but was for Loki, and LC3 only ever got mentioned in passing," recalled Quondam Sinclair programmer and occasional *Register* journalist Rupert Goodwins in 2002. **"I remember seeing a ULA design for it, but it was only pulled out of a cupboard for nostalgia reasons."**

More than 30 years on from those days, details of the proposed specification, **beyond the basic notion of implementing very little memory in order to keep the price as low as possible**, remain vague. Stephen does recall some of the work he did on the software. The operating system, he says, was **built out of a “little kernel” capable of multi-tasking. He may not have completed support for windowing - really just segmenting the screen into arbitrary independent areas - but he certainly built in the hooks for the mechanism behind such a system to be added later. “The design had to overcome the twin restrictions of low processor power and limited amounts of memory,”** he says.

“The LC3 OS was indeed written, in skeletal form,” said Goodwins in 2002. “[It had] **multitasking, windowing and was potentially very fast - a complete context switch in around a hundred T states**, ISTR. I don’t remember it being resurrected for Loki, but some of it may have been unearthed for Pandora.” Very possible, that, since Stephen Berry later designed the Pandora laptop’s system software.

One way of reducing the cost - and dealing with a low memory capacity - **was to fake up a bitmapped screen by making use of a character-based display**, Berry says. Text VDUs store a small grid of Ascii values which are used to look up appropriate entries in a character matrix table accessed by the display processor. **Change those character matrices - essentially treat them all as variable user-definable graphics - and you can replicate a bitmap screen and use less memory.** Or so the theory went.

Could the LC3 ever have come to market? That would have hinged on the Spectrum: would it have become cheap enough to produce for the price to be cut to around £50 or less, what Sinclair was selling the ZX81 for. Sinclair Research’s managing director, Nigel Searle, was, according to several ex-Sinclair staff, entirely unwilling to risk the company’s cash cow. That, plus the fact that an attempt to sell ROM cartridges for the Spectrum was a woeful failure - why buy £20 cartridges when tapes could be had for less than a fiver? - show that the economics would have to be very advantageous if the LC3 was to succeed.

Whether Brennan and Berry got an official go-ahead to begin development of the LC3 is unclear. Quite apart from the freedom Sinclair Research engineers enjoyed, the company was never one for formal approval processes and sign-offs. A nod from Clive Sinclair, Nigel Searle or even Jim Westwood would have been considered sufficient. However, unlike some projects, the LC3 did get beyond the proposal stage, and was even considered by management when the company’s leaders met in November 1983 to ponder the firm’s activities in 1984 and beyond. Since no serious Asian threats had emerged, and Spectrum production was getting cheaper, a line was drawn through the LC3.

“I still think the LC3 was the best approach,” said Sir Clive in a 1986 post-sale interview with *Sinclair User*. **“It was a complete colour computer, entirely on two chips - very much like the Japanese Nintendo machine but many years beforehand.”**

The idea was to fit it with a **Zilog Z80**, the same CPU as used in the ZX80, ZX81 and ZX Spectrum, along with a new **custom ULA that would provide the graphics and sound** plus minor functions, and a new operating system written by Stephen Berry that would interface directly with the ROM slot. **The ROM slot's positioning would allow a keyboard peripheral to be positioned on top of the main unit**, to make it look more like a proper computer when put together.

According to Berry himself, the operating system was built out of a **"little kernel" capable of multi-tasking, designed to, as he put it, "overcome the twin restrictions of low processor power and limited amounts of memory."** He might not have complete support for windowing (really just segmenting the screen into arbitrary independent areas), but added in the **proverbial hooks for the mechanism behind such a system to be added later.** Former Sinclair employee and occasional *Register* journalist Rupert Goodwins said in 2002 that the LC3's OS was **"indeed written, in a skeleton form, [It had] multitasking, windowing and was potentially very fast - a complete context switch in around a hundred T states, ISTR."**

**A BASIC interpreter, also written by Berry, would be available from launch day and loaded from a ROM cartridge. Standard mic and ear sockets would be provided to load and save from tapes when the LC3 is in full computer mode.**

To keep costs down, the **LC3 was given a small amount of memory**, and presumably, it could have been upgraded through an expansion slot or by using ROM cartridges with extra memory on them. Another method to make the system cheaper, along with dealing with its low memory capacity, was to use a unique display mode, where characters are used to, as Berry puts it, fake up a bitmapped screen. Text VDUs store a small grid of ASCII values used to look up appropriate entries in a character matrix table accessed by the display processor. **Changing the character matrices, meaning to essentially treat them all as variable user-definable graphics, would achieve the effect of replicating a bitmap screen using less memory.**

According to several ex-Sinclair engineers, the **LC3's design specifications were very much finalized**, and several wire-wrapped breadboards with TTL were assembled by Martin Brennan and provided to Berry for running the code he wrote for the system's operating system.

Ironically, despite the fact that Sir Clive Sinclair himself disliked video games and of how people would use the Spectrum for playing video games, he made some comments about the LC3 when asked about it in a 1986 *Sinclair User* interview, stating that it was the best approach for Sinclair due to being a complete colour computer on two chips.