Comparison of two computer architectures: PDP-4 and ICT 1300

Introduction

My assginment is to compare two computer architectures: PDP-4 and ICT 1300 systems. PDP-4 was made by Digital Equipment Corporation.It was a major American company in the computer industry from the 1960s to the 1990s. The company was co-founded by Ken Olsen and Harlan Anderson in 1957. ICT 1300 was made by International Computers and Tabulators. IT was a British computer manufacturer, formed in 1959 by a merger of the British Tabulating Machine Company (BTM) and Powers-Samas. In this topic we will discuss about computers internal achitecture like processors, registers, memory, etc.

2. Elementary base of PDP-4 computer's processor was descrete transistors and for memory were using magnetic core. It means that transistors were sold and you could replace them separetly. The PDP-4 was pretty big computer, its weight was around 450 kilograms. Its measured roughly 68cm × 171cm × 162cm.From a single source of 115-volt, 60-cycle, single-phase power, PDP-4 produces circuit operating dc voltages of -15 volts (± 1) and +10 volts (± 1) which are varied for marginal checking. Total power consumption is 900 watts.

ICT 1300 processor's base element was descrete Germanium PNP transistors. System has not got any integrated circuits, though they have PCB's those can be maintained. The computer weighs around 5.5 tonnes, and takes up around 6 by 7 meters of floor space. It used 13kW of power maximum, and 6.2kW at idle.

3. PDP-4 computer is an accumulator-based.The accumulator, AC, is the major register in the arithmetic unit. It serves both as an accumulator and as an in-out register.

ICT 1300 architecture were register-based, because it had only 3 data registers: A, B, C. Also there is 3 control registers.

ICT 1300 and PDP-4 had different architectures.

4. PDP-4 a single X winding and a single Y winding intersect at a single memory location containing an 18-bit core register. During each memory cycle information is read from or written into the single addressed core register. This addressed register is selected from among the 4096 (1024) registers in the core bank by selecting the single X winding and the single Y winding that intersect at the corresponding memory location.

ICT 1300 system as well as PDP-4 is a single-address based machine. A register takes single address at a time.

5. PDP-4 computer's control unit includes 3 internal registers: IR(instruction register-4bit), PC(program counter-13bit) and MA(memory register-13bit), and two console switch registers, AS(address switches) and ACS(accumulator switches) and those registers are specialised.The arithmetic unit includes 2 18-bit registers, AC(accumulator register) and MB(memory buffer register), and a 1-bit L register.

ICT 1300 architecture have 3 main registers. A register has a 48-bit Parallel connection to the IAS. It is used to write/read data to/from the IAS, Drum Store and Tape Store. Register B is used in most ALU calculations, and also would be the ALU link to the card punch, paper tape reader/punch and Teletype/line printer if the system had one. It was also used for bit-shifting. Register C is used for mutliplications and also for the card reader.Also there is 3 control registers of 48 bits width - control, branching, conditional.

6. PDP-4 have 2 flags: Link register wich often is used as overflow flag in 1's and 2's compliment and I/O flag.

ICT 1300 architecture have overflow flag and some tests like IAS-TEST (unofficial flag) wich used just to make a test for parity error catch of the system.

7. PDP-4 system have 18bit machine word.
ICT 1300 system holds 48 bits (12 decimal digits) plus 2 parity bits and combination makes them a machine word.

8. PDP-4 computer system have continuous type of memory layout.Its efective address is 12 bits.Extended version of PDP-4 with 15 bits addresses could work with up to 32K 18bit words, but usually it had 4K 18bit of words in capacity.
ICT 1300 architecture have continuous address space, because its architecture is pretty simple compared to even PDP-4 system. Maximum amount of memory was 3000 words. Because word is 48 bits so its around 14K.

9. PDP-4 system do not have virtual memory, because CPU is working directly with memory, with real addresses.
ICT 1300 architecture does not have virtual memory as well as PDP-4 system.

10. PDP-4 is 18 bit, accumulator-based, single-address instruction set. Computer's logic is divided into 4 classes: control unit, arithmetic unit, memory and input-output system. This system have 16 instructions. There are 3 classes of PDP-4 instructions: memory reference instructions like: AND Y, JUMP Y, XOR Y, LAC Y, DAC Y, DZM Y, etc. operate instructions like: RAL,RTL, etc. and basic IOT instructions like: IOF, ION, etc.
ICT 1300 system is 48 bit, register-based, single-address instruction set.
Architecure is devided into 4 classes: control unit, arithmetic unit, memory management unit and input-output unit. Control unit hold instructions like: ALL-OFF(load standart program cards),20(write drum stop),21(zero drum), etc.

11. PDP-4 architecture support direct and indirect addressing modes.
ICT 1300 supports only direct addresing mode bacause even compared with PDP-4 architecture, its pretty simple. Well both systems support direct addresing mode, but ICT 1300 does not support indirect addressing mode.

12. Flexible, high-capacity input-output capabilities of the PDP-4 enable it to
operate in conjunction with a variety of peripheral devices, such as perforated-tape readers and punches, punched-card readers and punches,
Teletype printer-keyboard, line printers, magnetic tape transports, and
analog-to-digital converters.
ICT 1300 can handle some peripherals as PDP-4 architecture: The ICT 1300 can use many type of peripherals. These include the IBM 082 Card Sorter, and the IBM 129 Card Reader/Writer. A Teletype was available but rarely used. A Line Printer was also a common. Optional: magnetic tape.

13. PDP-4 has program interrupt control permits one of 11 lines (conditions) or
input-output devices to interrupt the program and initiate a subroutine which may return to the original program when the cause for interruption has been processed. The machine state is preserved during a Program Interrupt. This type of interrupt is suited for information or event rates in the range of 0 to 2,000 cycles per second. Data interrupt control allows a device to automatically interrupt the program and deposit or extract data from the Core Memory at an address specified by the device. The Data Interrupt is suited for high speed information transfers; up to 125,000 18-bit words may be transferred per second.
By the simplicity of ICT 1300 and because it was unbuffered, it does not have interruption support. Taking this into account, they were completely different.

14. PDP-4 architecture have double-precision floating point package wich provides floating point arithmetic with a 36-bit mantissa and 18-bit exponent. The routines include plus, minus, divide, multiply, fix-to-float, and float-to-fix, with decimal input and output.

ICT 1300 system used decimal instead of binary as raw, as well as for instructions, also principal functions have single character mnemonics, but the programmer still has to remember the indicator numeric codes. So this architecture supports only 2 types: decimal digits and sterling digits.

15. With data interruption is suited for high speed information transfers; up to 125,000 18-bit words may be transferred per second. The clock/timer produces a signal which increments a Core Memory register at a rate of 60 cycles per second. The Clock produces a pulse every 1/60 second (16.6 milliseconds).
Basic instructions require only 8 or 16 microseconds to be completely executed.
The cycl e time (the time required to read inFormation from memory and rewrite information back into me'mory) is 8 microseconds. The access time (the time required to read information from memory) is 2 microseconds.

ICT 1300 was slightly faster because system did not have buffer. Core speed is 1 microsecond per cycle. Simple addition took 21 clock cycles, hardware multiplication averaged 170 clock cycles per digit. Paper Tape Reader at 1,000 characters per second. Paper Tape Punch at 300 characters per second. Memory average access time was 5.7 ms.

16. PDP-4 do not use cache memory.

ICT 1300 system as well as PDP-4 architecture do not use cache memory.

17. PDP-4 was a general-purpose computer. It was used for mathematical operations because instead of supporting only 1's compliment, it also can support 2's compliment. Also it can have many kinds of different I/O equipment, as well as data storage because it can store information on magnetic tape.

ICT 1300 computers one of its main attraction was that architecture performed British currency calculations (pounds, shillings and pence) in hardware. This architecture mostly was used for banking system like payrolls, slips.

18. PDP-4 architecture had an assembler that could interpret mnemonic to machine code and can work with Fortran II compiler, though with minimal source.

ICT 1300 architecture work directly with on drums, dont have any assemblers, compiler or software.

Conclusion

PDP-4 and ICT 1300 computer architectures were made around 1960s. Regarding that both had same technical resources like magnetic drum or tape, germanium coils, etc. In most aspects systems were similar by memory type or by ISA instructions. But also architectures were different by registers or by equipment and internal parts they were using. Thats why PDP-4 was more general purpose and more compact by its size. ICT 1300 was opposite to PDP-4. Because system had limitations(decimal machine code) its purpose was mostly to handle banking systems, payrolls, etc. Also ICT 1300 was huge machine, was pretty demanding for cooling, electrical suply.

References:
https://www.computerhistory.org/collections/catalog/102733305/
https://en.wikipedia.org/wiki/Programmed_Data_Processor
https://t-lcarchive.org/ict-1301/
https://ict1301.virtualcolossus.co.uk/technical.html?utm_source=chatgpt.com
https://en.wikipedia.org/wiki/ICT_1301
https://en.wikipedia.org/wiki/International_Computers_and_Tabulators
http://www.ict1301.co.uk/13010130.htm
https://www.youtube.com/watch?v=ZLpUyU2boAM&t=1502s
https://en.wikipedia.org/wiki/Digital_Equipment_Corporation