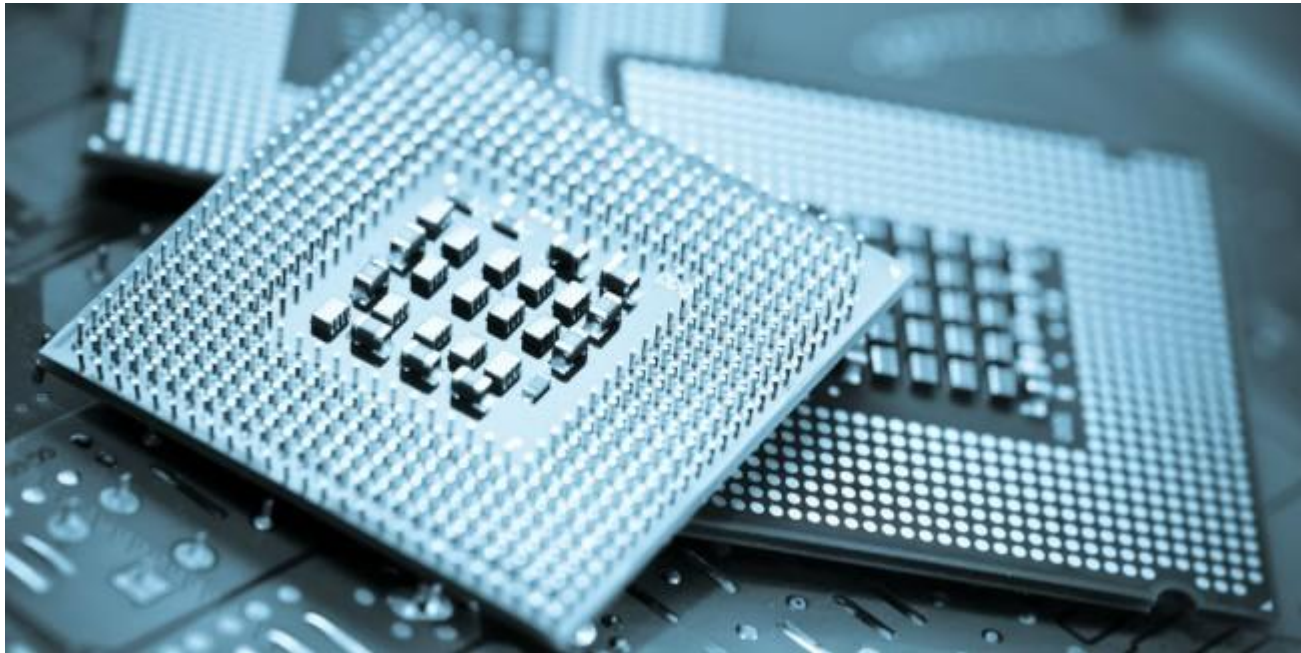


Возрастающая сложность микропроцессоров – прогресс или путь в никуда?





КАНОНИ
НЕМЫН , ХРГОВЪ СЛВНЫМ
ВЕЛИКОМЧИНЕ ОУРЕ ВЪЧНОМЪ
ПОКОМЪ ТРЕЗОВНИЧЕ , И ВЕЛ
КИМЪ ТИ СТРАДАНІИ НЕ ПРЕХО
ДИМОЕ И БЫВАЕ ПОКОНИЦЕ ПРІ
ШЕРЕТЫН . ШЕ НЕХОДИМО
ТИМНИЦЫ И ТОМАНИА НЕПРЕ
СТАННОГО И НУЖДЫ , ПОГЦІ
СА БГОПРІАТНЫМИ ТИ МАТВА
МИ ИЗБАВИТИ РАБЫ ОУМНАН
НЫА , ЗА НИХЪ ЖЕ МОАНЫ
ТА ПРІТОАЩЕ И ВО ОУЩЕРАДІИ
ВЗЫВАЮЩЕ ИПОАНИ НАШЕ ПРО
ШЕ , И ХРГЪ БГА МОАИ

ОКРЪЩЕНІА МА БГЗ
ЧИСЛЕННЫМИ СОГРЕШЕНИИ ДБО ,
ХОДІТАИТЕВОМЪ ТИ ШЕНОВІ ,
ОУЩЕРАДІИ МИ ХІШ , И СЛОВО
ПОДІВІИ ВОПІТИ , БАГІНА
ДАЖЕ БГА ПЛОТІВ ПОМОЖАШИ .
ПРАВО ИЗ ПЛАМЕНИ ОУЩЕРАДІИ
ЧІ , І ПРІВІДНОГО ЖЕРТВЕ И
КОС ПАПІИ , ВЛА КО ТВО
РІИИ ХРГЪ СЛІКА ХОЩЕИ ,
ТАКА ТА ПРІВІДНОГО
ГЛА ВО ВЪЩЕ
ПОШЕИТЕ МНІ МОЛІТЕ ,





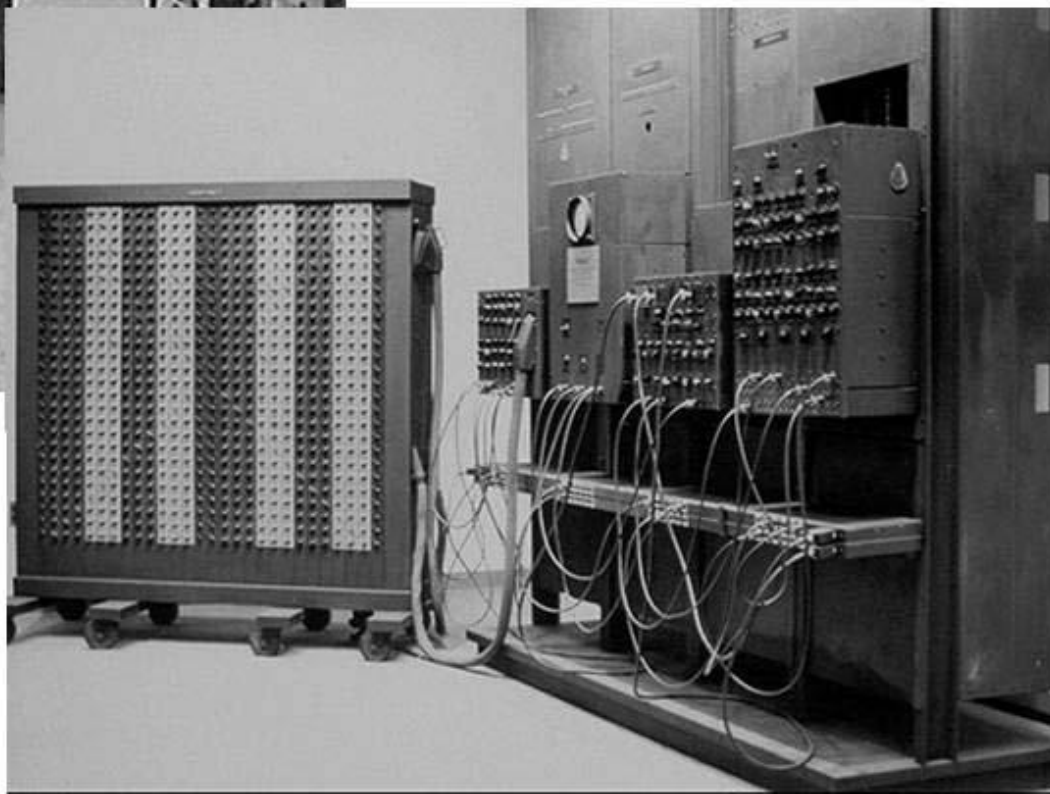
ENIAC – первый цифровой ламповый компьютер

Electronic Numerical Integrator and Computer 1944



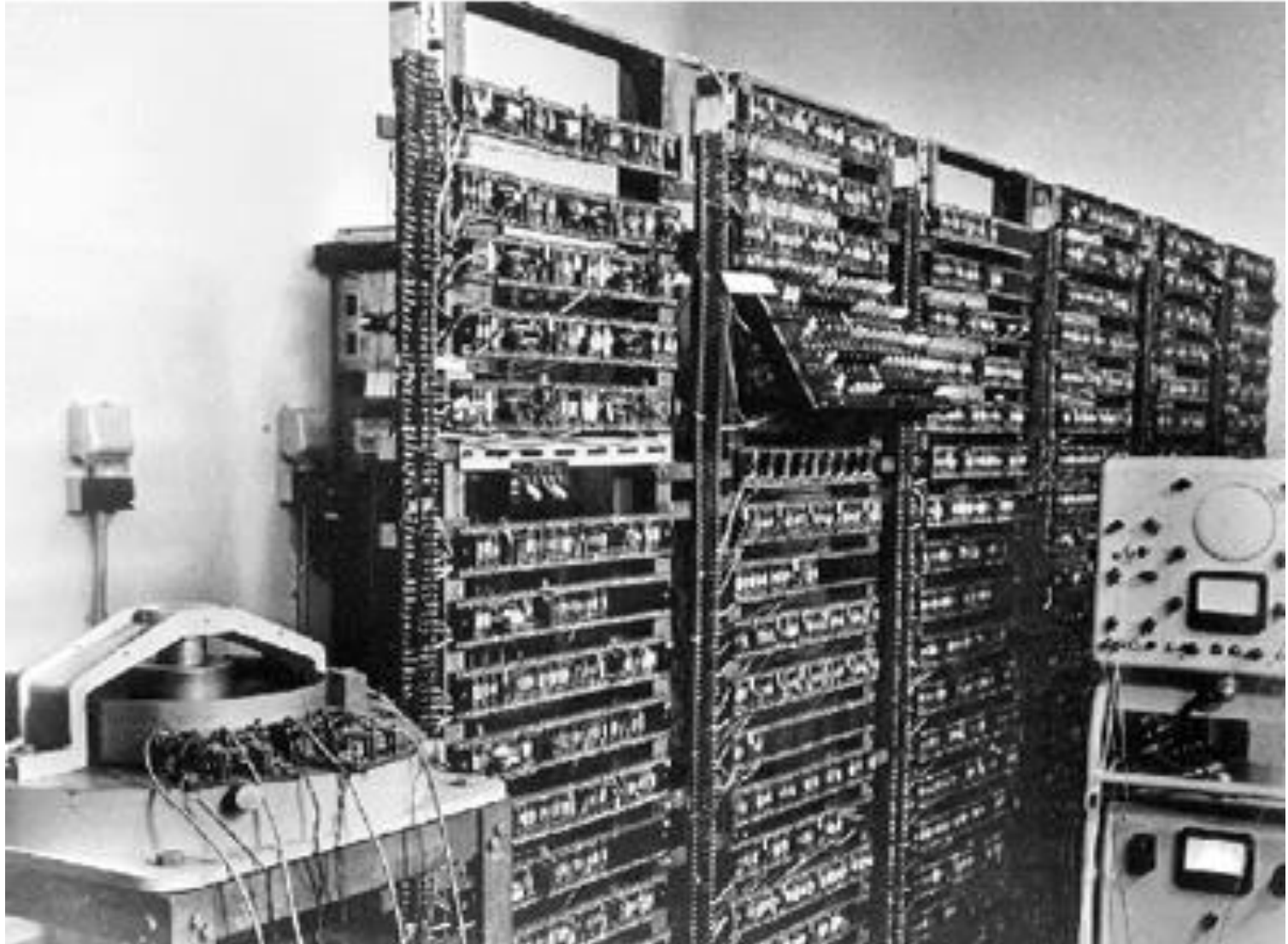
John Presper Eckert

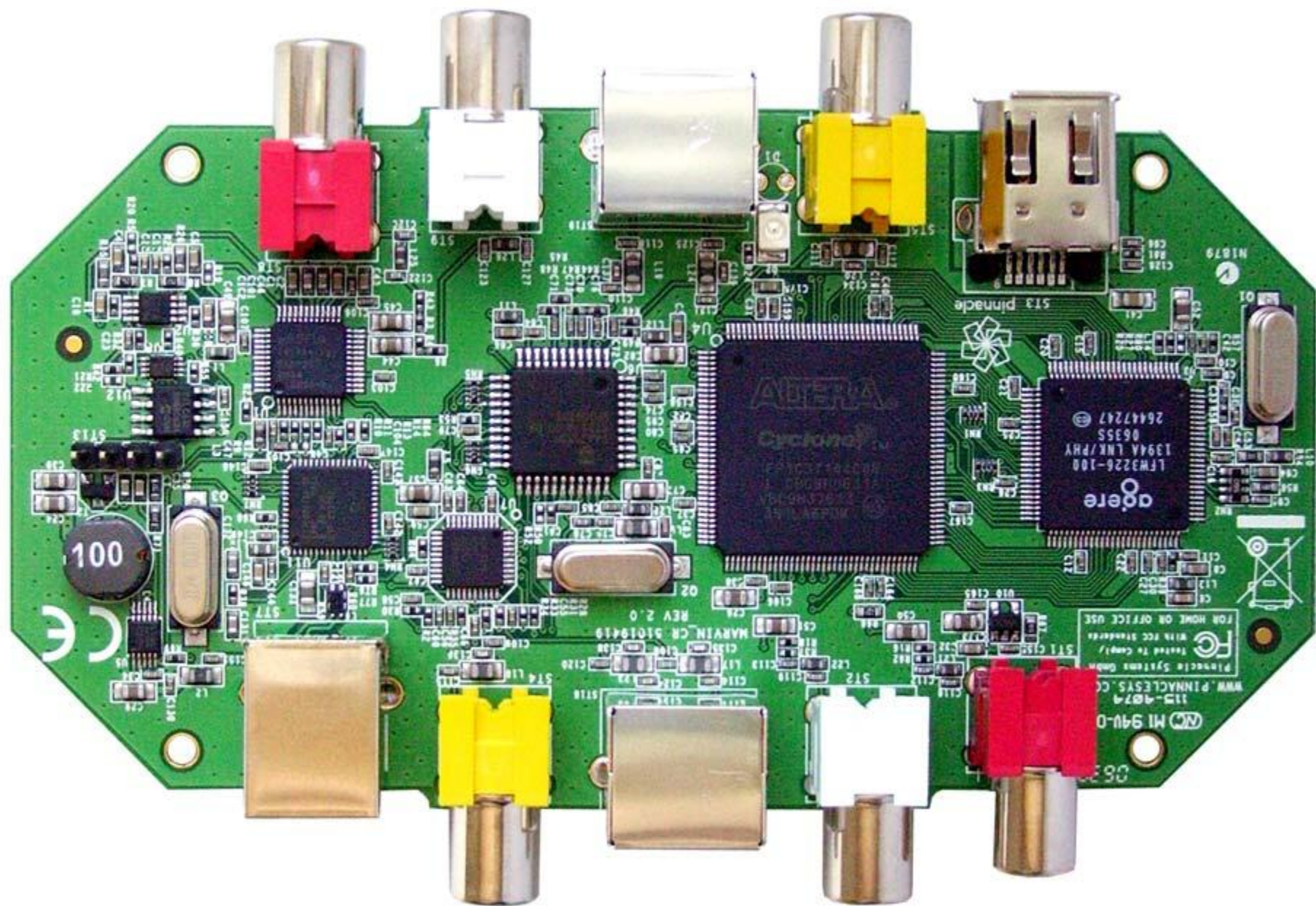
18000 электронных ламп
70000 резисторов
160 кВт потребляемая
мощность

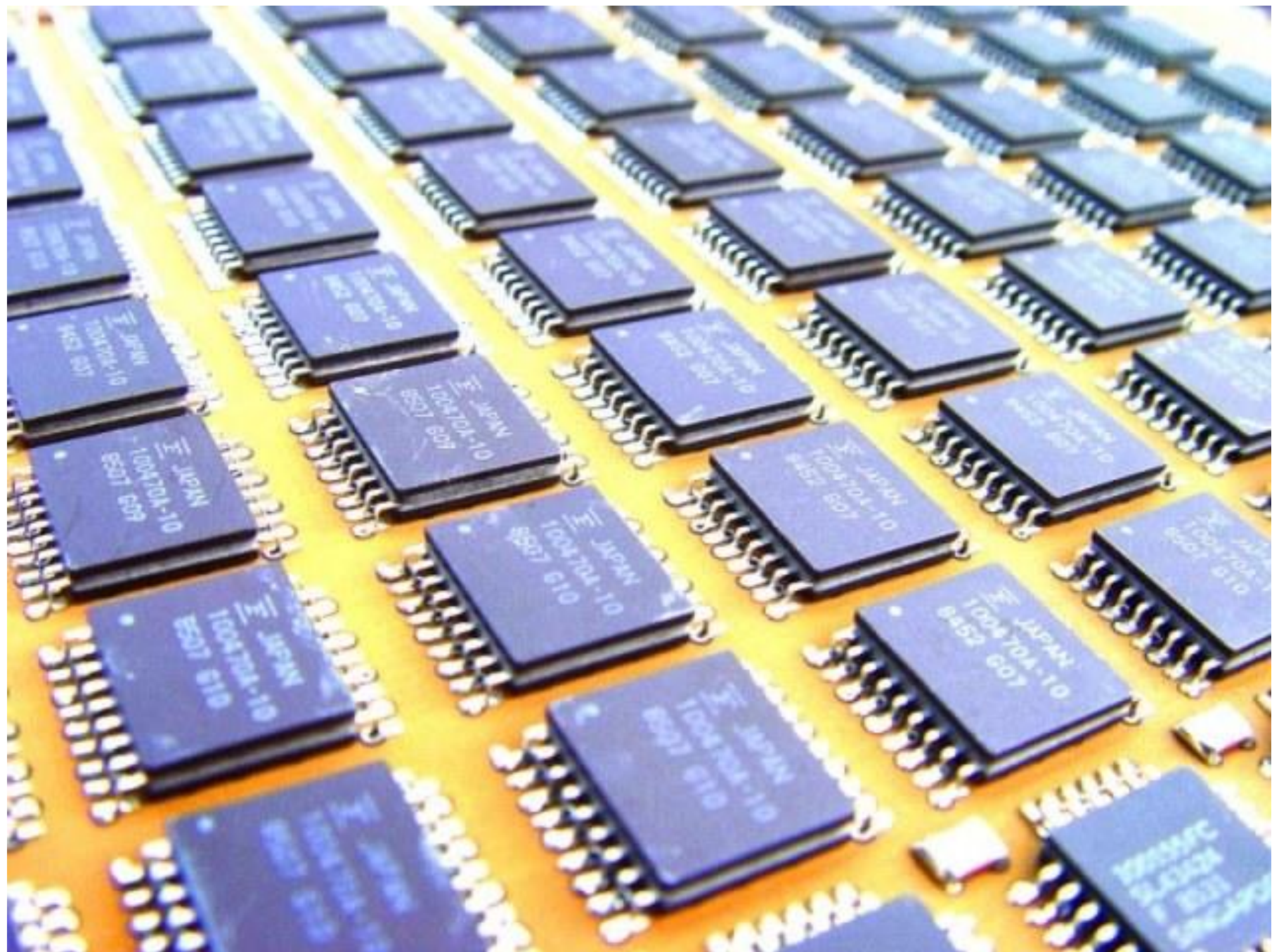




Транзисторный компьютер

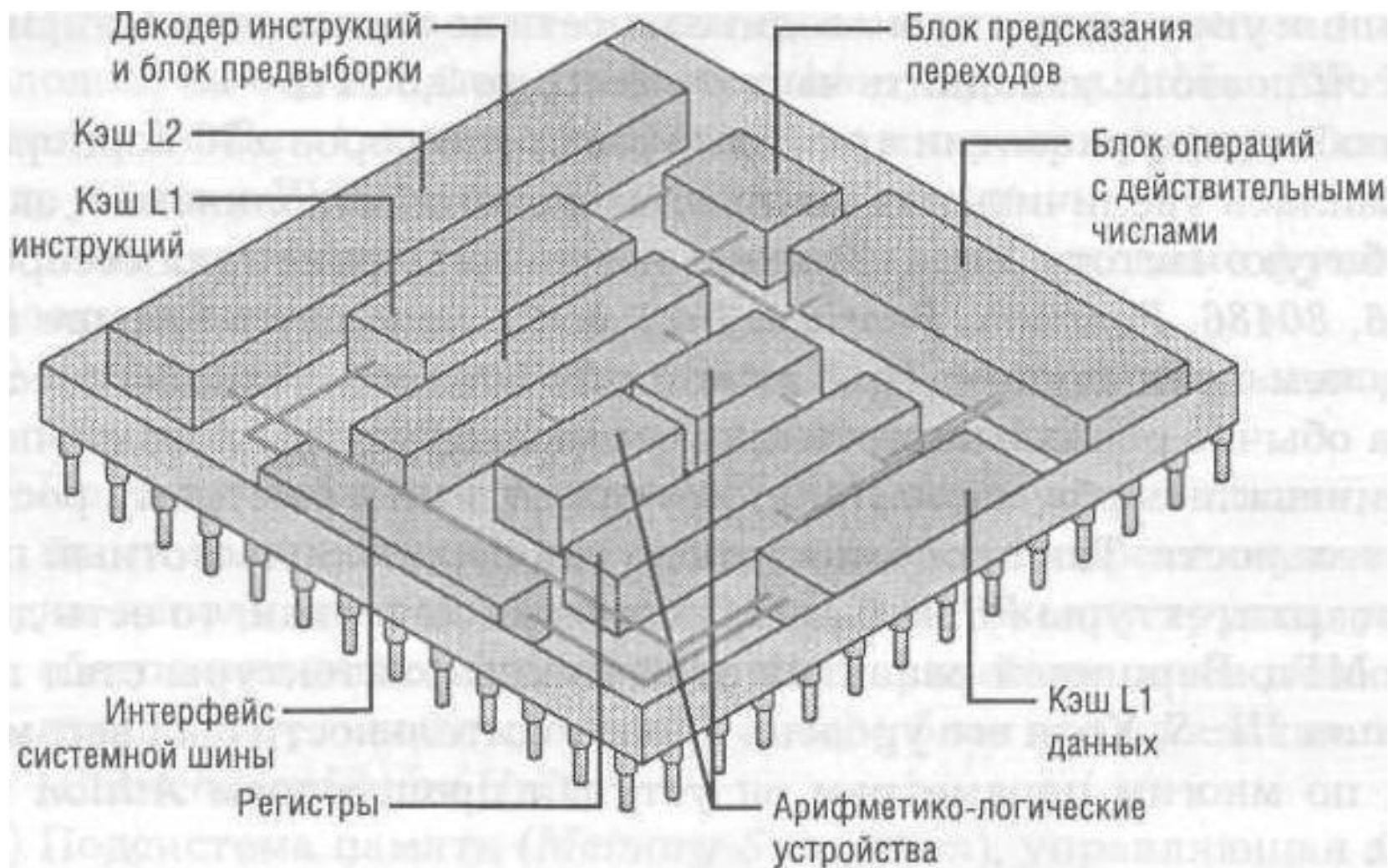




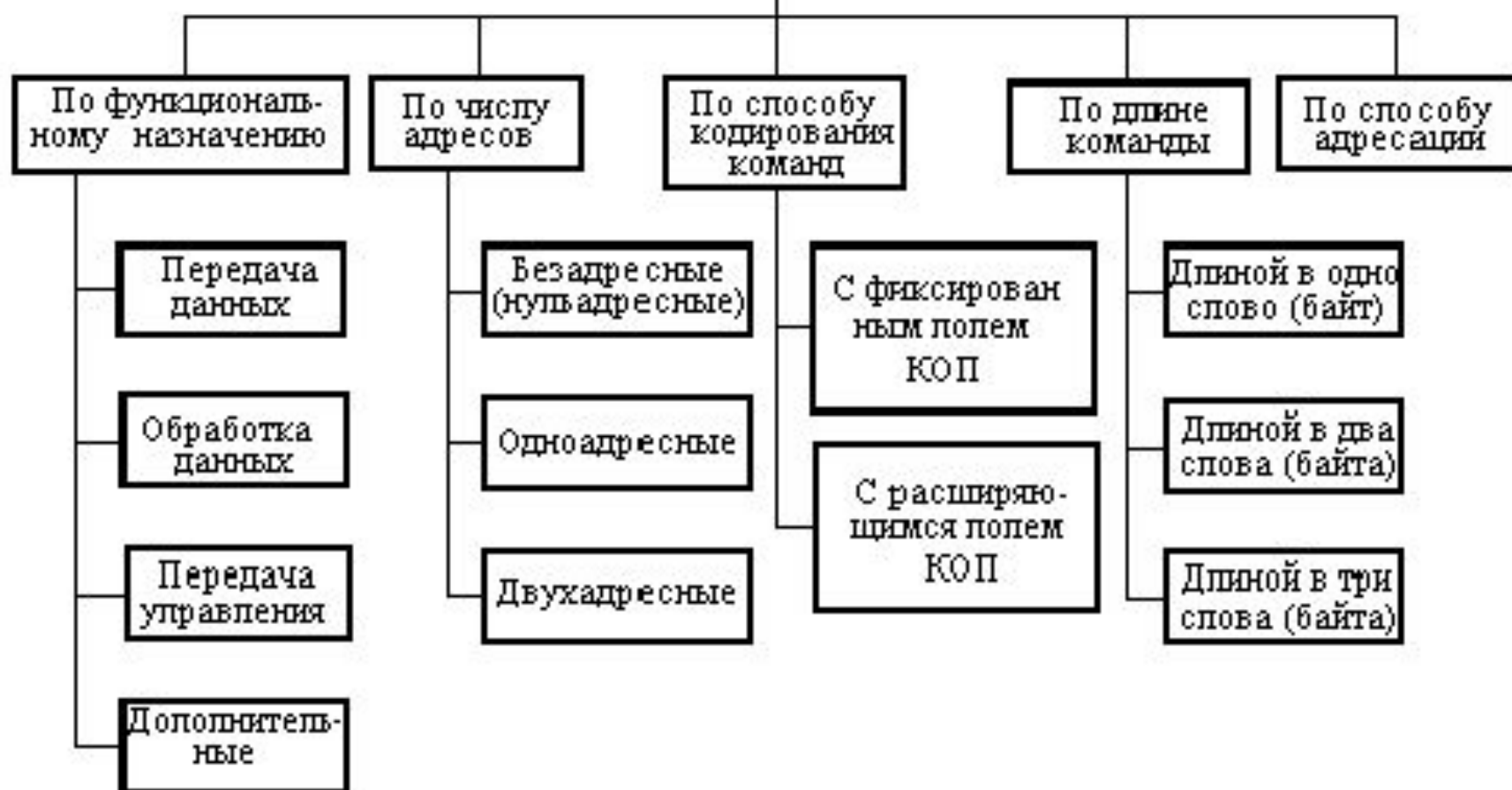




Архитектура микропроцессора



Команды

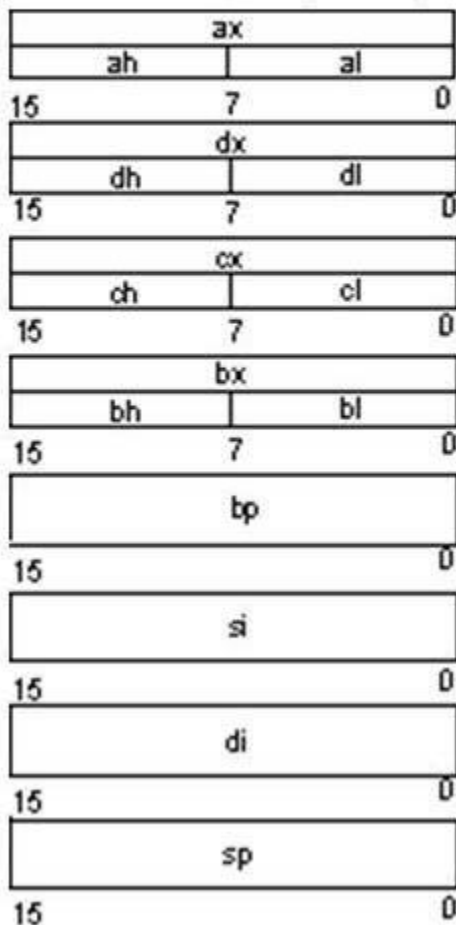


Разрядность микропроцессора

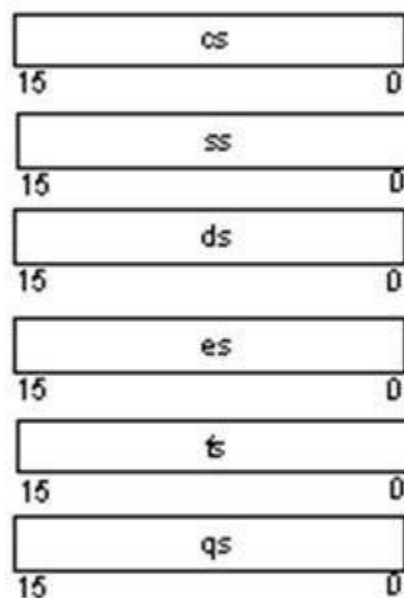


Регистры процессора

Регистры общего назначения (РОН):



Регистры сегментов:



Регистры состояния и управления:

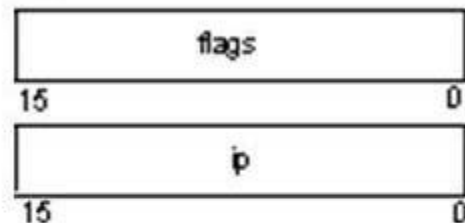


Таблица – Основные характеристики микропроцессоров

Набор команд	Разрядность, бит	Год появления	Архитектура	Кол-во регистров
System/360 /System/370 /z/Architecture	64 (32→64)	1964	CISC	16
CDC Cyber	60	1970	RISC	24
8080	8	1974	CISC	8
Z80	8	1976	CISC	17
Elbrus (<u>native</u> VLIW)	64	1976	VLIW	8-64
MIPS	64 (32→64)	1981	RISC	4–32 (включая "ноль")
NS320xx	32	1982	CISC	8
SPARC	64 (32→64)	1985	RISC	32 (включая "ноль")
PA-RISC (HP/PA)	64 (32→64)	1986	RISC	32
DLX	32	1990	RISC	32
Alpha	64	1992	RISC	32 (включая "ноль")
M32R	32	1997	RISC	16
MMIX	64	1999	RISC	256
Itanium (IA-64)	64	2001	EPIC	128
65k	64 (8→64)	2006	CISC	1
eSi-RISC	16/32	2009	RISC	8–72
RISC-V	32, 64, 128	2010	RISC	32 (включая "ноль")
ARMv8-A	64/32	2011	RISC	32 (включая "ноль")

CISC

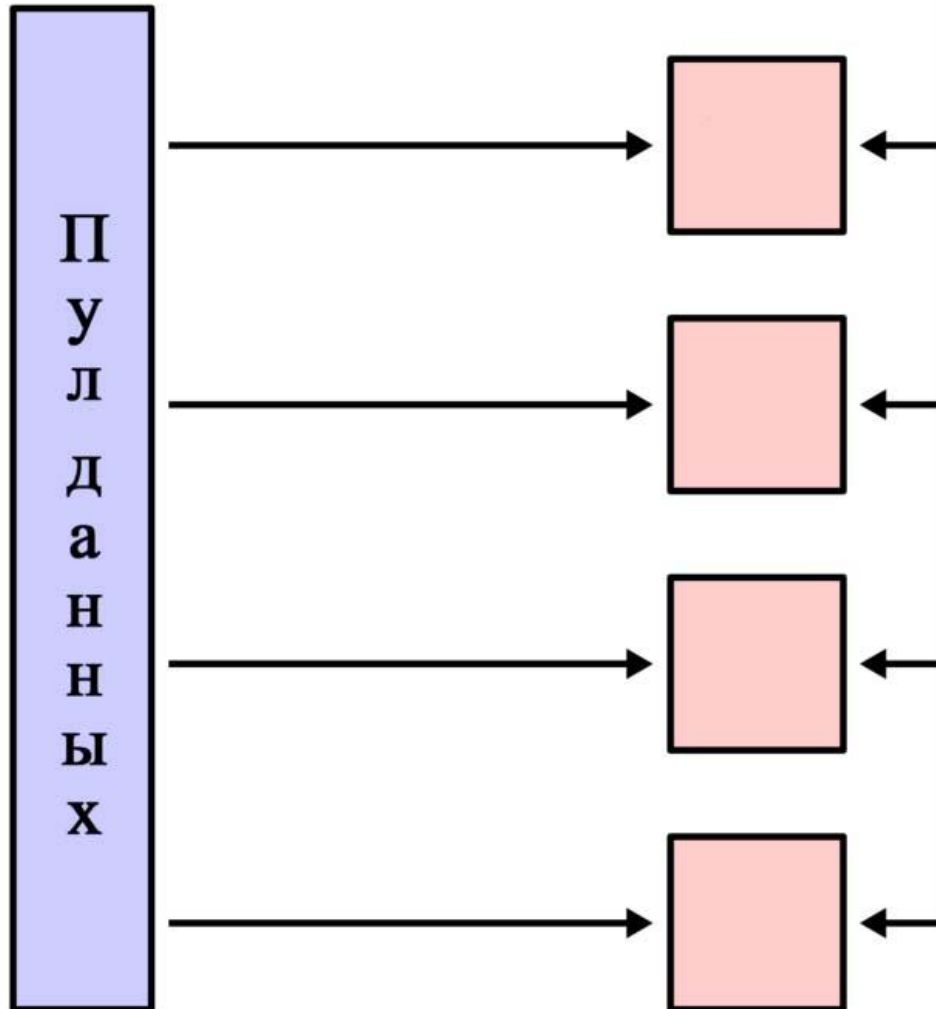


RISC



SIMD
(ОКМД)

Пул команд





НИКС

**КОМПЬЮТЕРНЫЙ
СУПЕРМАРКЕТ**

CINEBENCH R15.0

File Help



OpenGL --- Run
CPU **2220 cb** Run

Your System

Processor Genuine Intel CPU 0000
Cores x GHz 18 Cores, 35 Threads @ 2.20 GHz
OS Windows 8, 64 Bit, Professional Edition (build 9
CB Version 64 Bit
GPU Board Quadro 600/PCIe/55E2
Info

Ranking

CPU	Details
1. 22C/44T @ 2.20 GHz, Intel Xeon CPU E5-2696 v4	3092
2. 18C/36T @ 2.30 GHz, Intel Xeon CPU E5-2699 v3	2433
3. 18C/36T @ 2.20 GHz, Genuine Intel CPU 0000	2220
4. 16C/32T @ 2.30 GHz, Intel Xeon CPU E5-2696 v3	2171
5. 14C/28T @ 2.60 GHz, Intel Xeon CPU E5-2697 v3	2080
6. 14C/28T @ 2.30 GHz, Intel Xeon CPU E5-2695 v3	1935
7. 12C/24T @ 2.66 GHz, Intel Xeon CPU X5650	1279
8. 4C/12T @ 3.30 GHz, Intel Core i7-3930K CPU	1096
9. 4C/8T @ 4.40 GHz, Intel Core i7-4770K CPU	822

Your Score Identical System

MAXON

3D FOR THE REAL WORLD



AIXSPONZA®

Click on one of the 'Run' buttons to start a test.

Сложность микропроцессоров

Микропроцессор

- $> 10^9$ транзисторов
- $> 10^7$ строк на Verilog
- ~ 4 -10 ядер

Проектирование

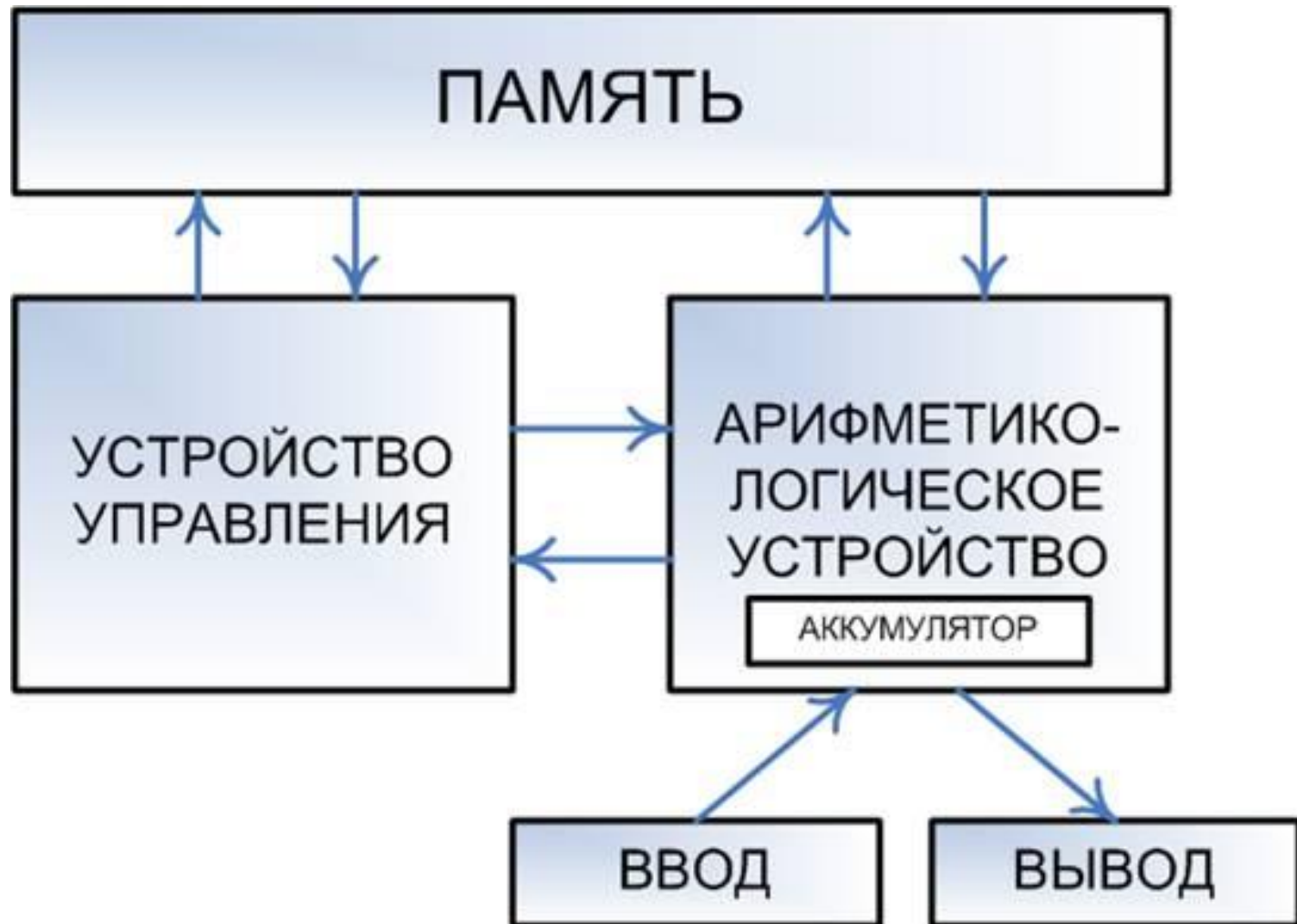
- > 500 разработчиков
- ~ 3 -4 года работы
- > 100 млн долларов



Верификация – более 60% затрат на проектирование микропроцессора!

- $> 10\,000$ ошибок проектирования (в спецификациях, Verilog-коде и т.д.)
- > 100 инженеров-верификаторов (модели, тесты, формальные методы)
- > 1000 компьютеров (круглосуточное моделирование и прогон тестов)

Архитектура Фон Неймана



The UML class diagram illustrates the architecture of the MarkovChain application. It features several classes and their interactions:

- EditorWindowWidget** (purple box) is a central component that interacts with **MarkovEditorWidget**, **CompilerError**, **MarkovAlgorithm**, **MarkovRule**, **MarkovAlphabet**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, **RunError**, **MainWindow**, and **LineInfoWidget**. It receives signals like `showLineHighlight`, `removeLineHighlight`, `markovAlgorithmChanged`, `canRun`, `breakPointAdded`, `breakPointRemoved`, `sourceCodeChanged`, `newSourceCode`, `lineWithErrorFocus`, and `lineWithoutErrorFocus`. It sends signals like `sourceCodeChanged` and `newSourceCode`.
- MarkovRunManager** (purple box) interacts with **EditorWindowWidget**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `canRunAlgorithm`, `runStarted`, `runFinished`, and `runWithDebug`. It sends signals like `run` and `runWithDebug`.
- FileManager** (purple box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `sourceCodeChanged` and `historyChanged`. It sends signals like `setNewSourceCodeFromFile`.
- SourceCodeManager** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `sourceCodeChanged` and `setNewSourceCodeFromFile`.
- MarkovParser** (purple box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovAlgorithm**, **MarkovRule**, **MarkovAlphabet**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `historyChan`, `inputWordSelected`, and `removeFromHistory`. It sends signals like `fileNameChanged` and `hasUnsavedData`.
- YadFile** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **MarkovAlgorithm**, **MarkovRule**, **MarkovAlphabet**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `fileNameChanged` and `hasUnsavedData`.
- HistoryManager** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `historyChan`, `inputWordSelected`, and `removeFromHistory`. It sends signals like `historyChanged`.
- HistoryWidget** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `historyChan`, `inputWordSelected`, and `removeFromHistory`.
- InputWidget** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `setInput` and `addToHistory`. It sends signals like `canRunAlgorithm`, `runStarted`, and `runFinished`.
- RunWidget** (purple box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `run` and `runWithDebug`.
- DebugRunWidget** (purple box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `run` and `runWithDebug`.
- MarkovWordWidget** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `run` and `runWithDebug`.
- RunError** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `run` and `runWithDebug`.
- MainWindow** (black box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`.
- LineInfoWidget** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`.
- CompilerError** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`.
- MarkovEditorWidget** (purple box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`. It sends signals like `sourceCodeChanged` and `newSourceCode`.
- MarkovAlgorithm** (purple box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`. It sends signals like `sourceCodeChanged` and `newSourceCode`.
- MarkovRule** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`.
- MarkovAlphabet** (blue box) interacts with **EditorWindowWidget**, **MarkovRunManager**, **FileManager**, **SourceCodeManager**, **MarkovParser**, **YadFile**, **HistoryManager**, **HistoryWidget**, **InputWidget**, **RunWidget**, **DebugRunWidget**, **MarkovWordWidget**, and **RunError**. It receives signals like `lineWithErrorFocus` and `lineWithoutErrorFocus`.

Андрей Андреевич Марков (1903-1979)



Польский
электронный
аналоговый
компьютер
«АКАТ-1»



