

Programmabl System on a ~~Chip~~

Lazányi János

2009



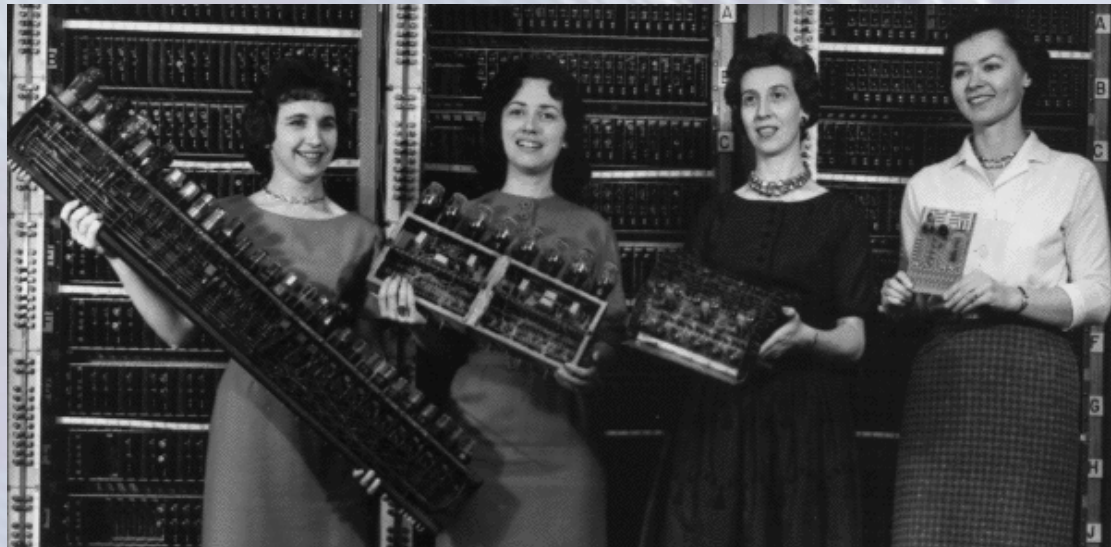
Tartalom

- **A „hagyományos” technológia**
- **SoC / PSoC**
- **Multicore**
- **SoPC**
- **Fejlesztés menete**

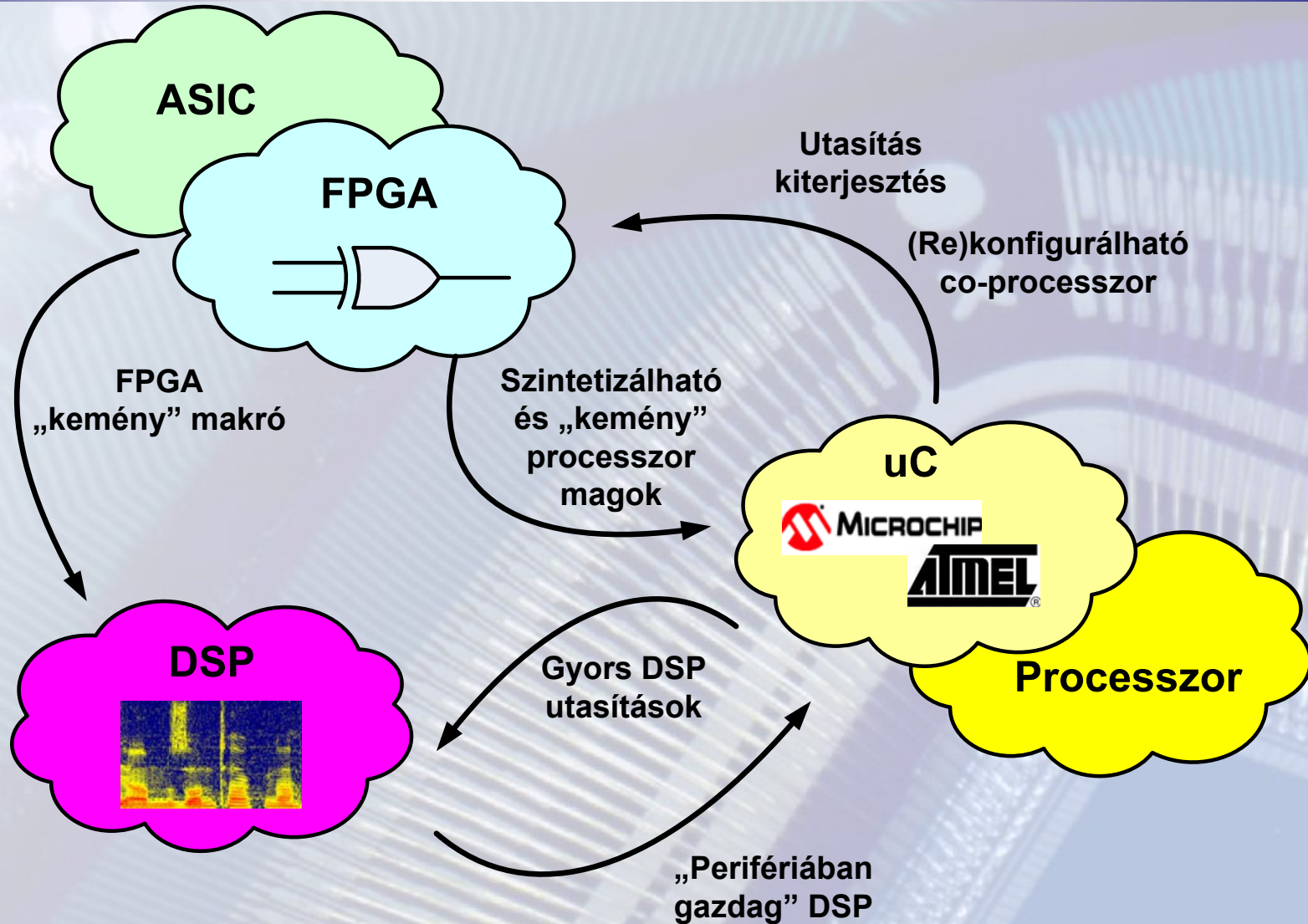




A hagyományos technológia



Elmosódó határvonalak

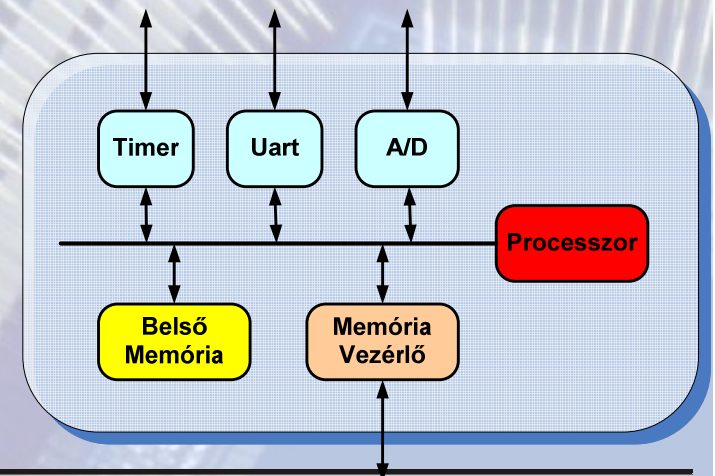




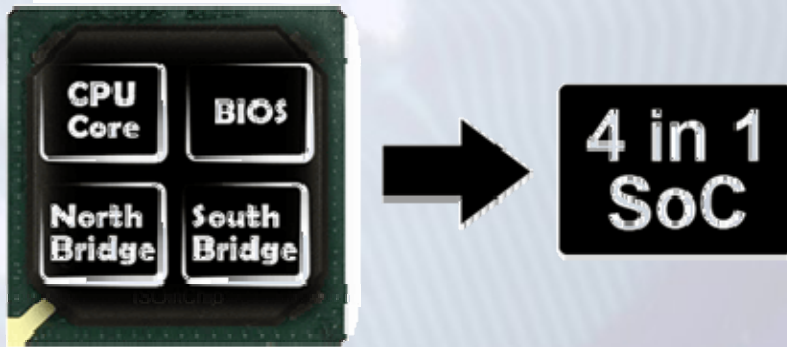
SoC
PSoC

SoC (System-on-Chip)

- Egy chipes rendszer, amely analóg, digitális és MEMS (micro-electro-mechanical system) részeket tartalmaz (*IBM*)
- Egy chipes rendszer amely analóg és digitális egységeket tartalmaz. (*Lucent*)
- Egy chipbe integrált digitális rendszer (*Synopsys*)

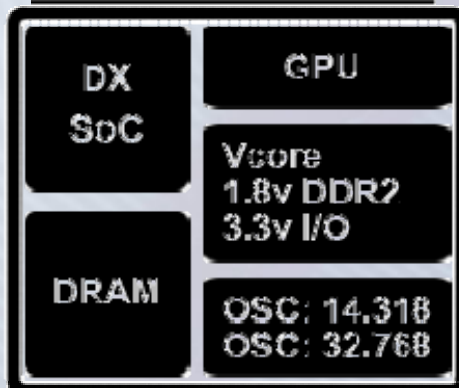


Vortex x86 SoC



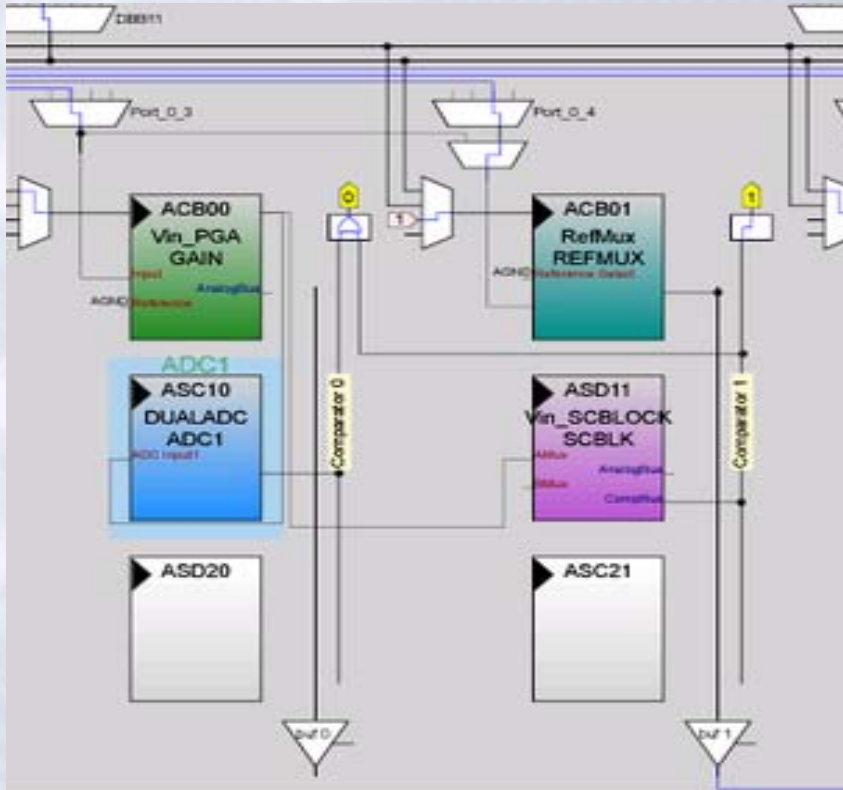
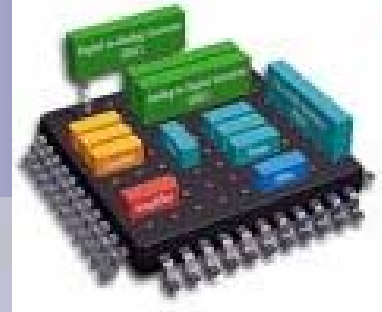
- 600MHz- 1 GHz
- 256 K L2 Cache
- Embedded BIOS
- 16 bit DDR2 controller
- PCI + ISA +LPC
- USB 2.0 + 5 x RS232
- IDE + GPIO

Vortex86DX CPU Board



Power Consumption 5 Watts

PSOC (Cypress)



- **Microcontroller**
- **16 digitális blokk**
 - pl. PWM
- **12 analóg blokk**
 - Erősítők
 - Kapcsolt-kapacitás

Minden út SoC irányba vezet

Virtex 5 FPGA (Xilinx)

5 bemenetű LUT technológia

550 Mhz

1 Mbyte BRAM memória

4 GEthernet MAC

PCI Express (x8)

1000+ I/O láb

16 csatorna Rocket IO

TMS320C6474 DSP (TI)

3 db 16 bites fix pontos mag

1 Ghz

3 Mbyte L2 RAM

GEthernet MAC

PCI interfész

64ch DMA

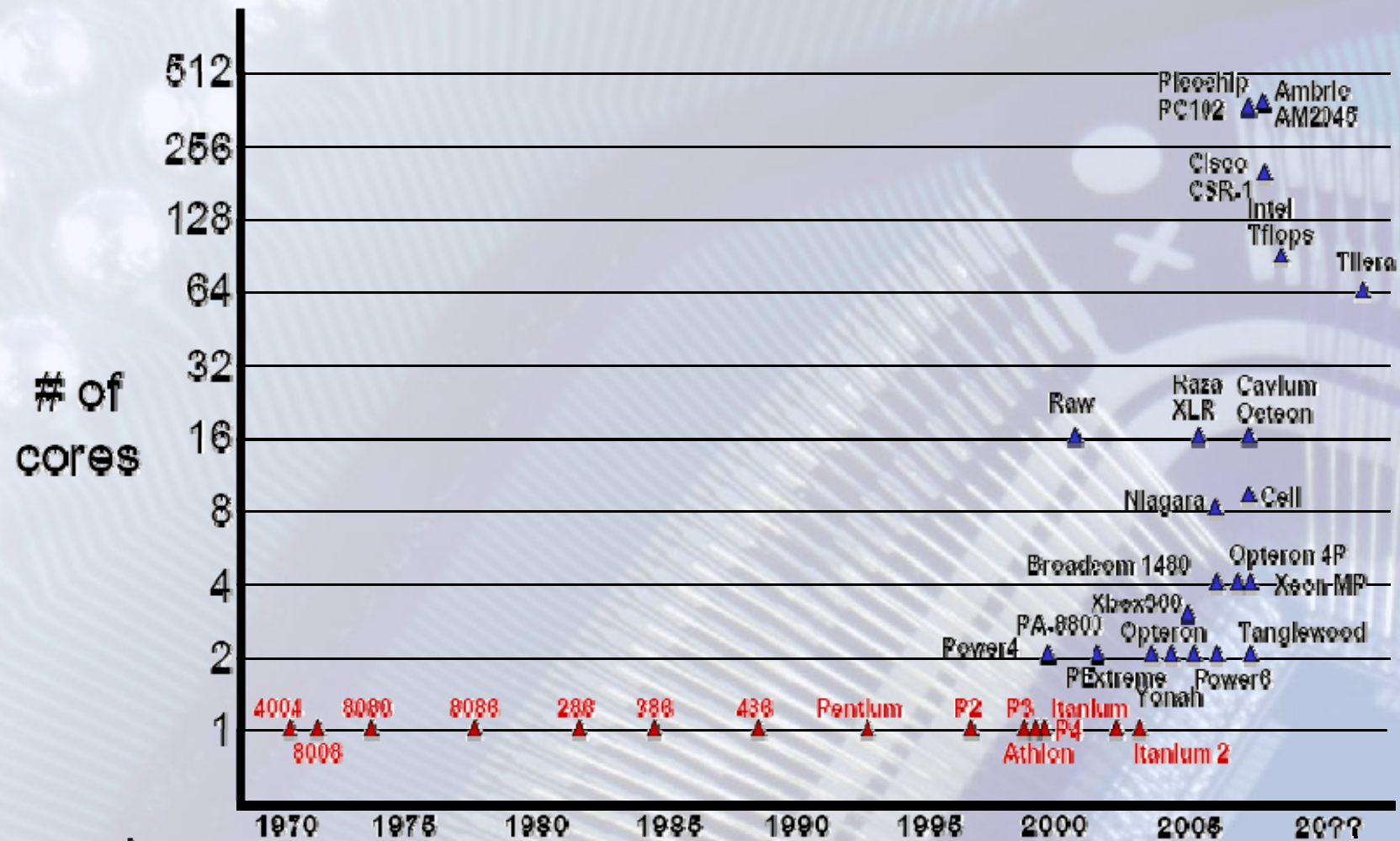
Rocket IO



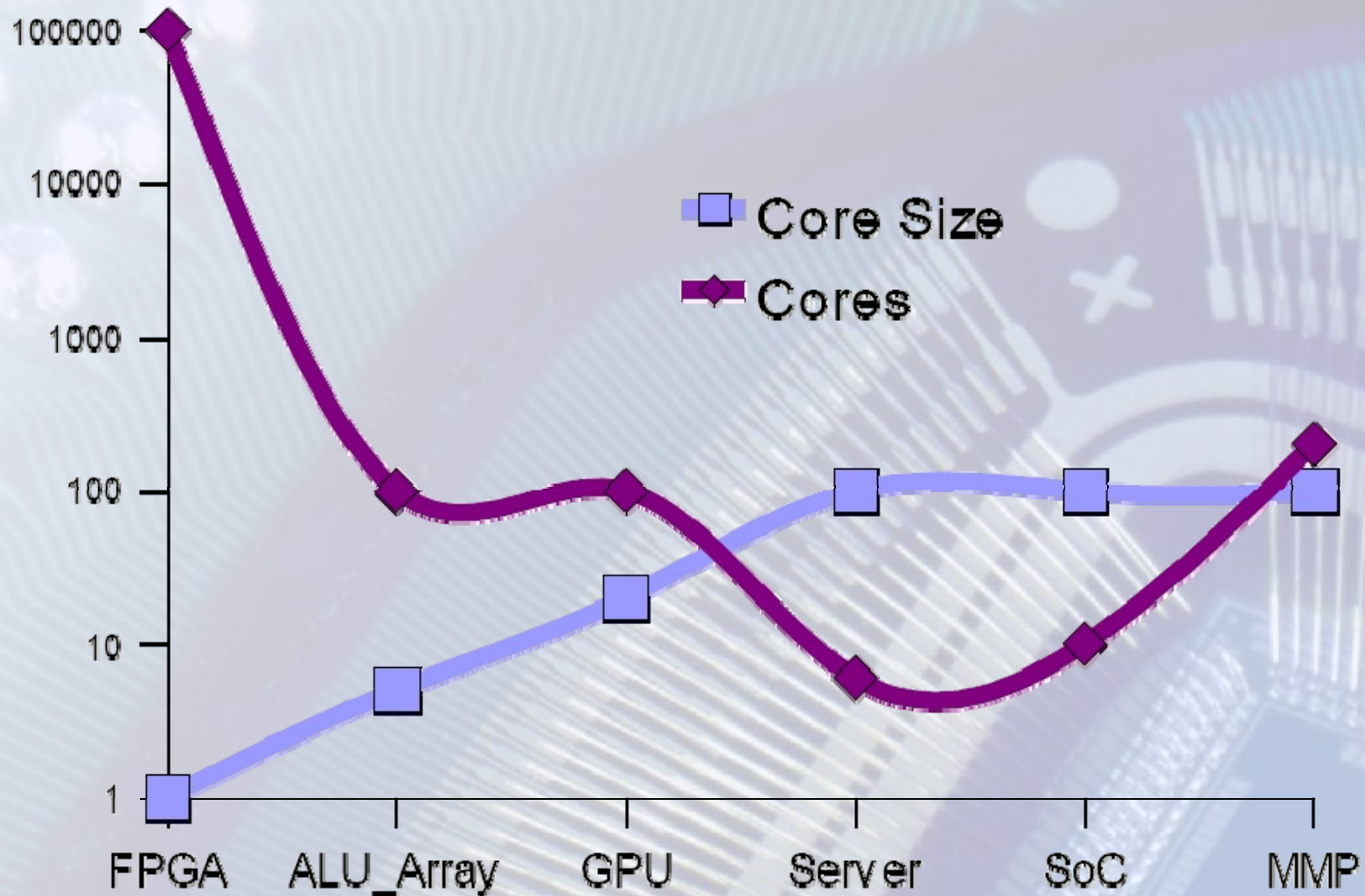
Multicore



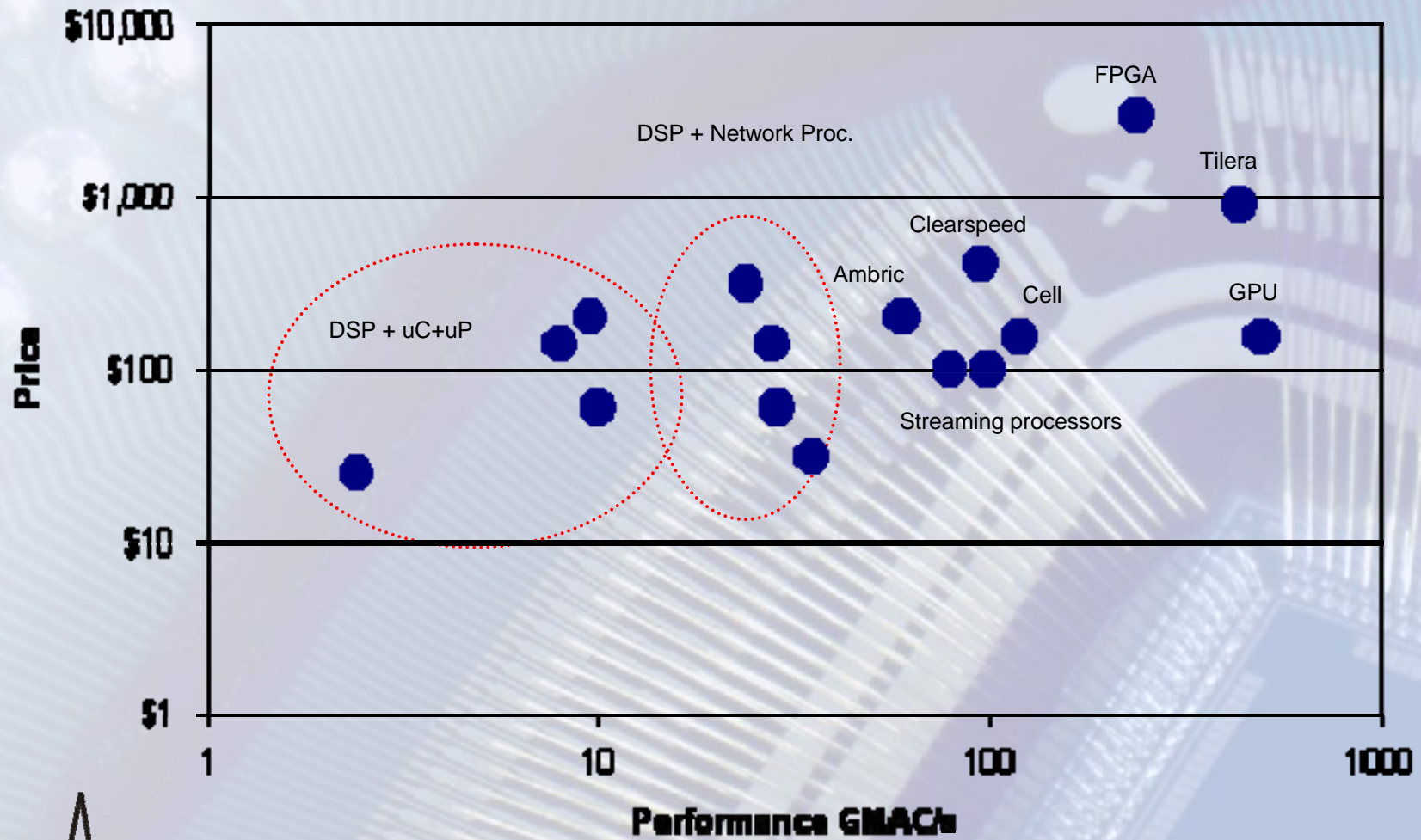
Magok száma



Granuláltság



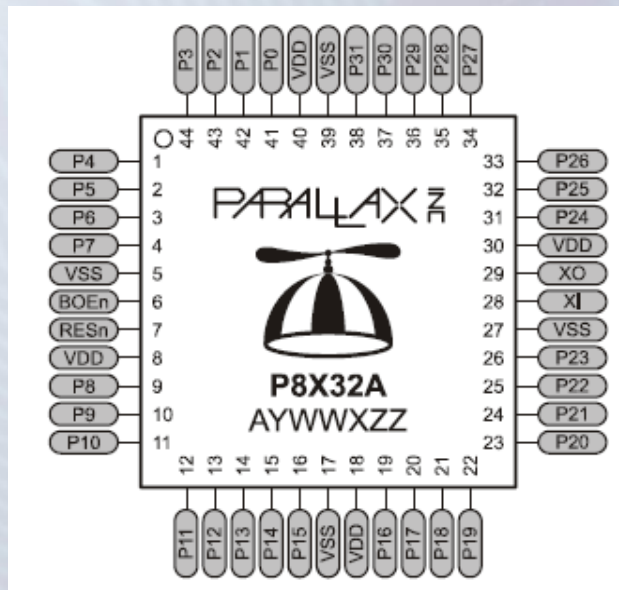
De mennyibe kerül?



Két minta

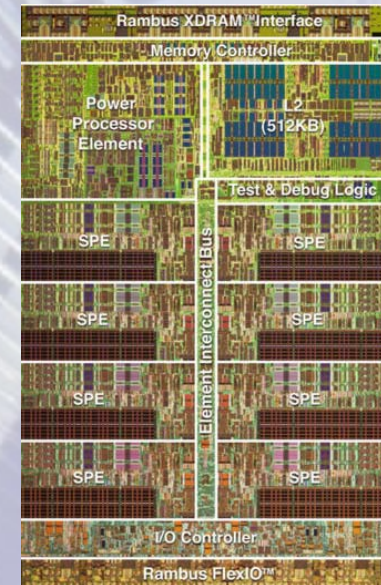
Prolific Propeller

- 8 egyszerű mag
- 8 x 20MIPS
- \$ 10

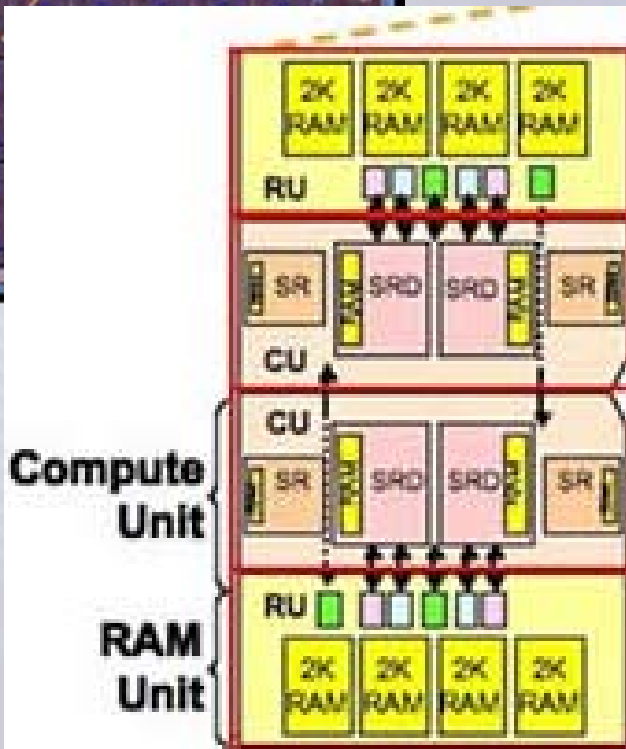
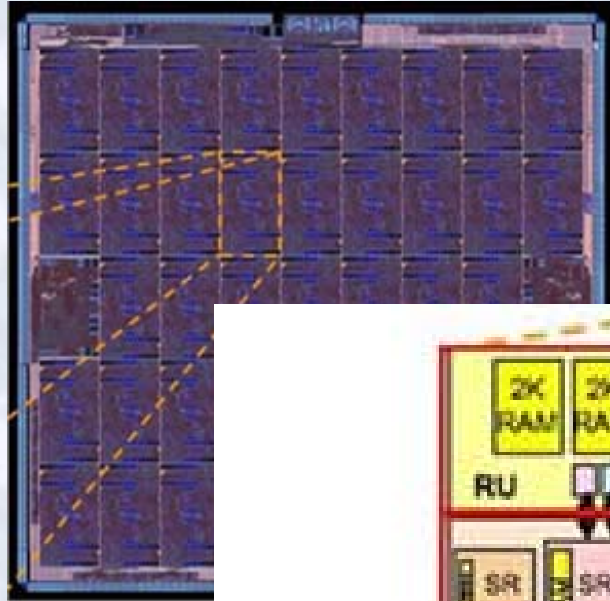


Cell BE

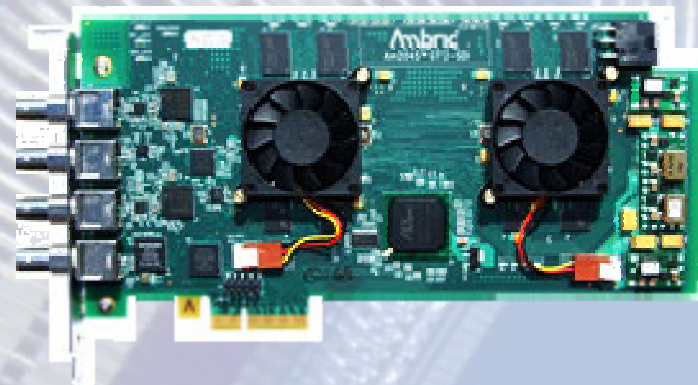
- 8 x SPE (SIMD)
- 15 GFLOP
- 1 xPPE (PowerPC)
- 25 GFLOP



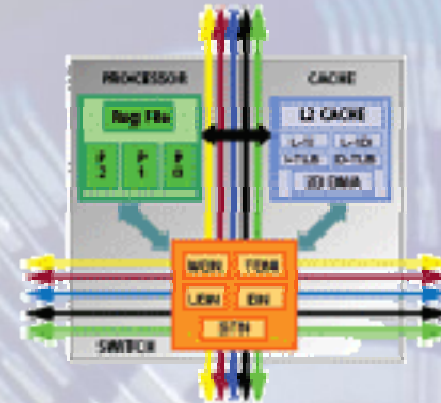
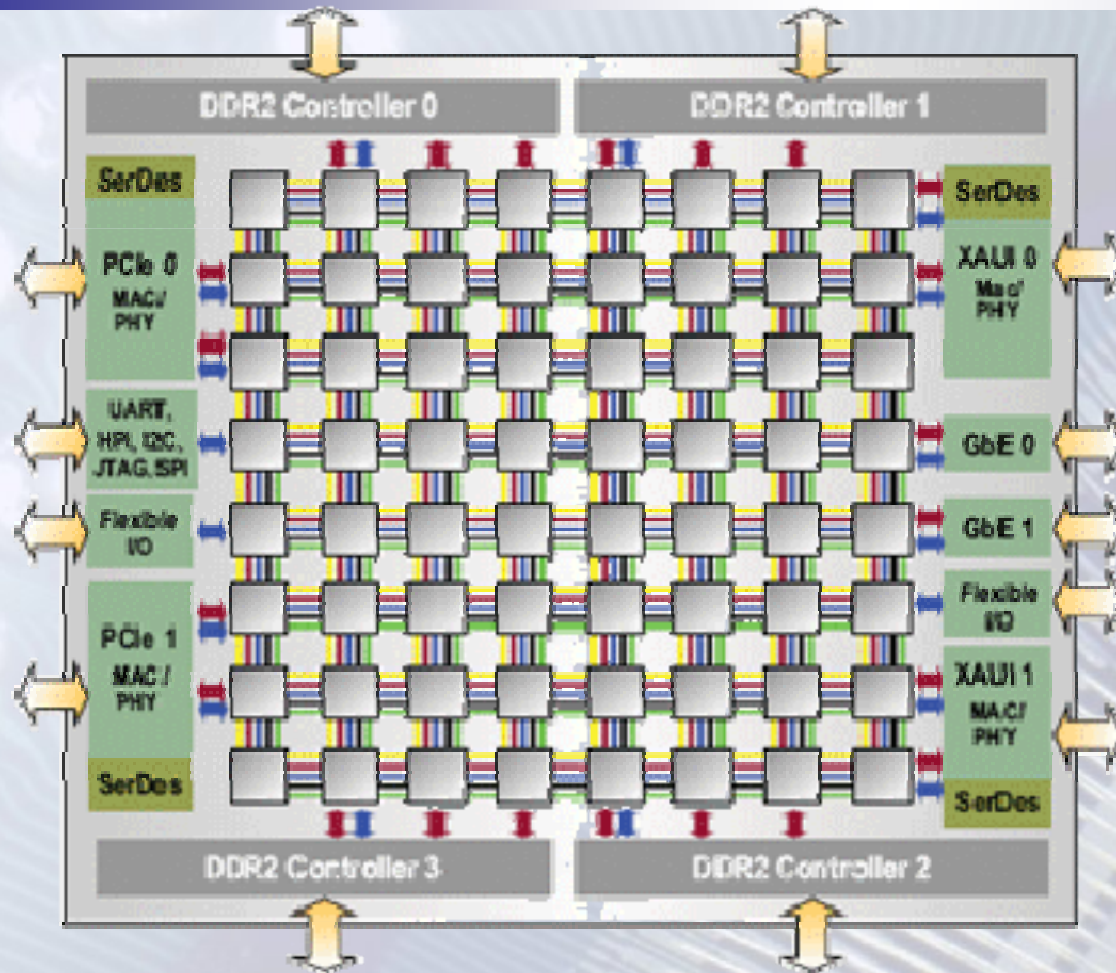
Ambric Am2045



- 336 32 bit processzor @ 350 MHz
- 7.1 Mbit belső RAM
- 60 GMACs (16 bit)
- 2 x DDR2
- 4 lane PCIe
- 15 W power
- \$ 100

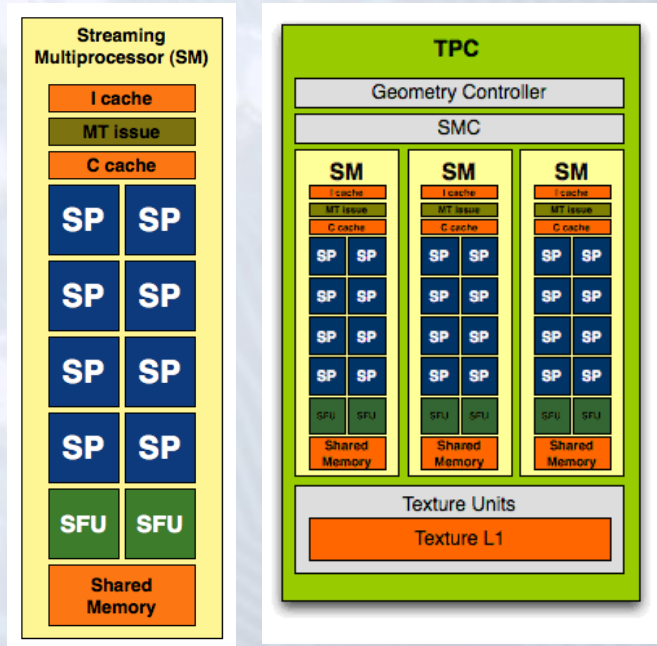


Tilera TilePro64



- 64 Mips Core
- 700 Mhz
- 20 W
- 4 x DDR2
- 2 x GE
- 2 x 4 lane PCIe
- Linux
- \$ 1000

Stream processzorok



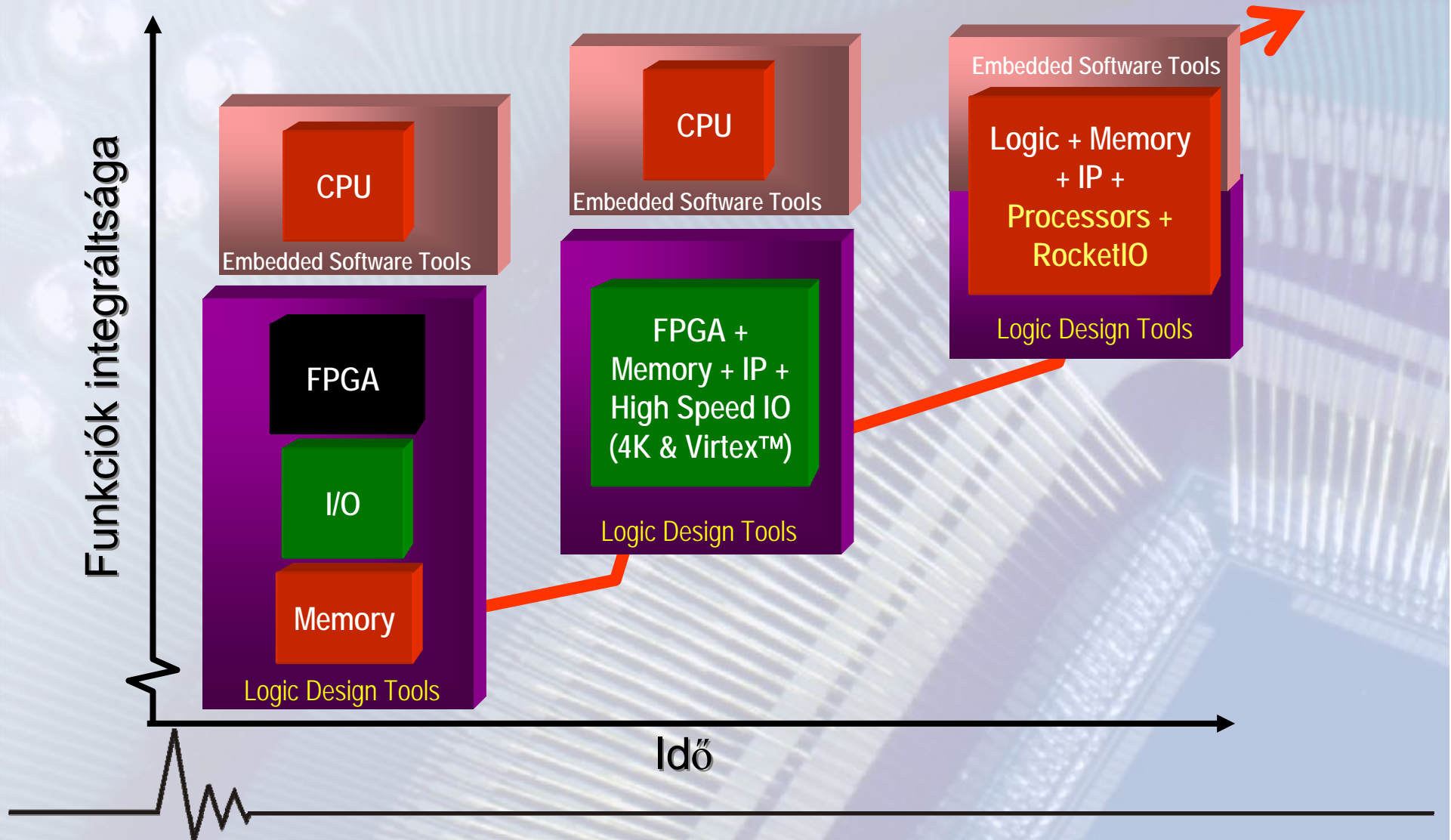
- 240 skalár processzor
- 1300 Mhz frekvencia
- 512 bit memória busz

Nvidia G200

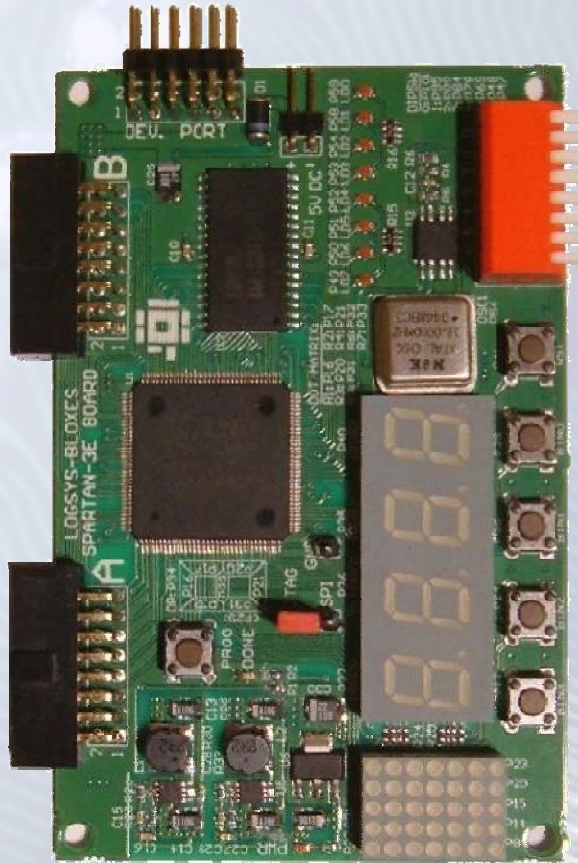
SOPC



Az FPGA integráció fejlődése

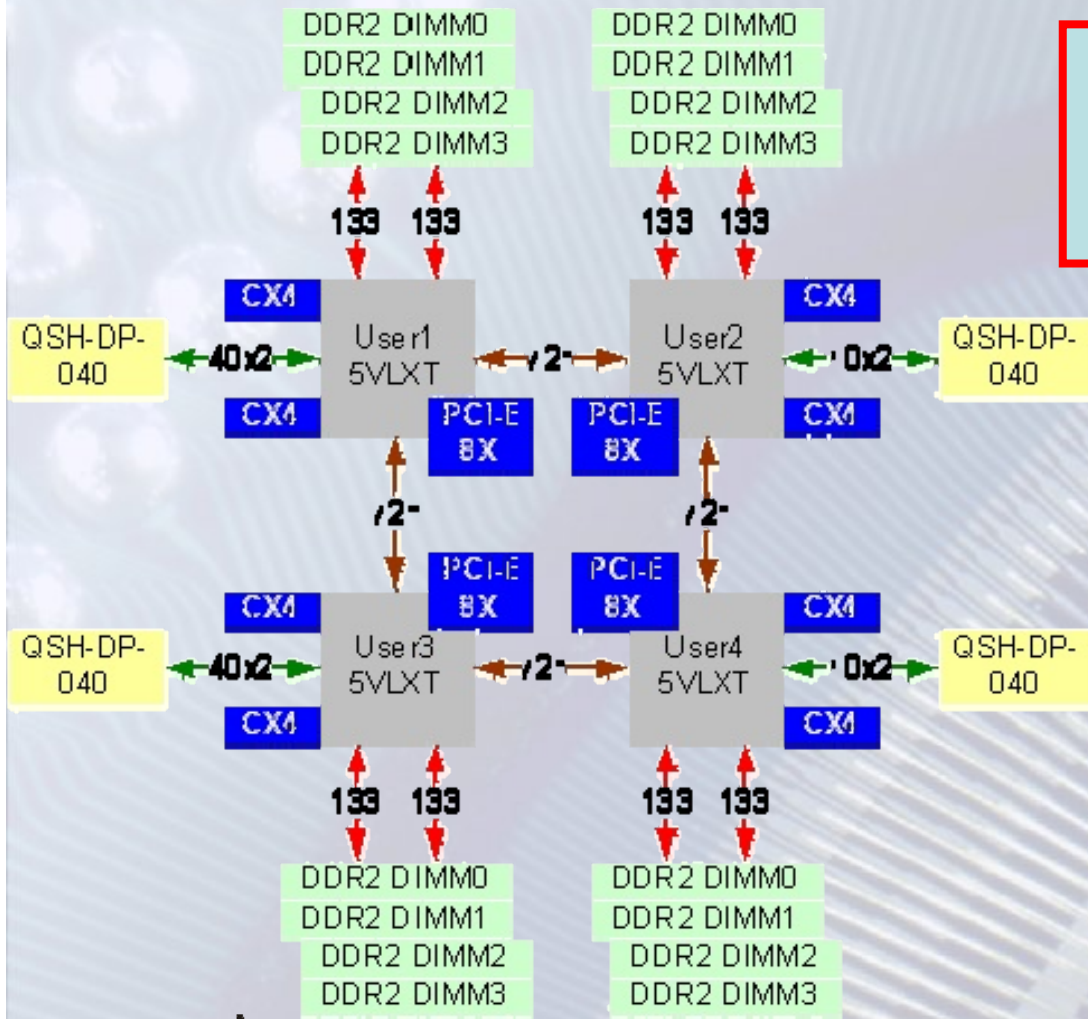


Logsys Spartan-3E



- **1 x Spartan 3 FPGA (\$ 20)**
 - 250 ezer kapu
 - 12 BRAM
 - 12 szorzó
- **SRAM**
- **FLASH**
- **LED etc.**

BEE 3



- 32 Microblaze / FPGA
- 4x OpenSPARC T1 (w. Cache)

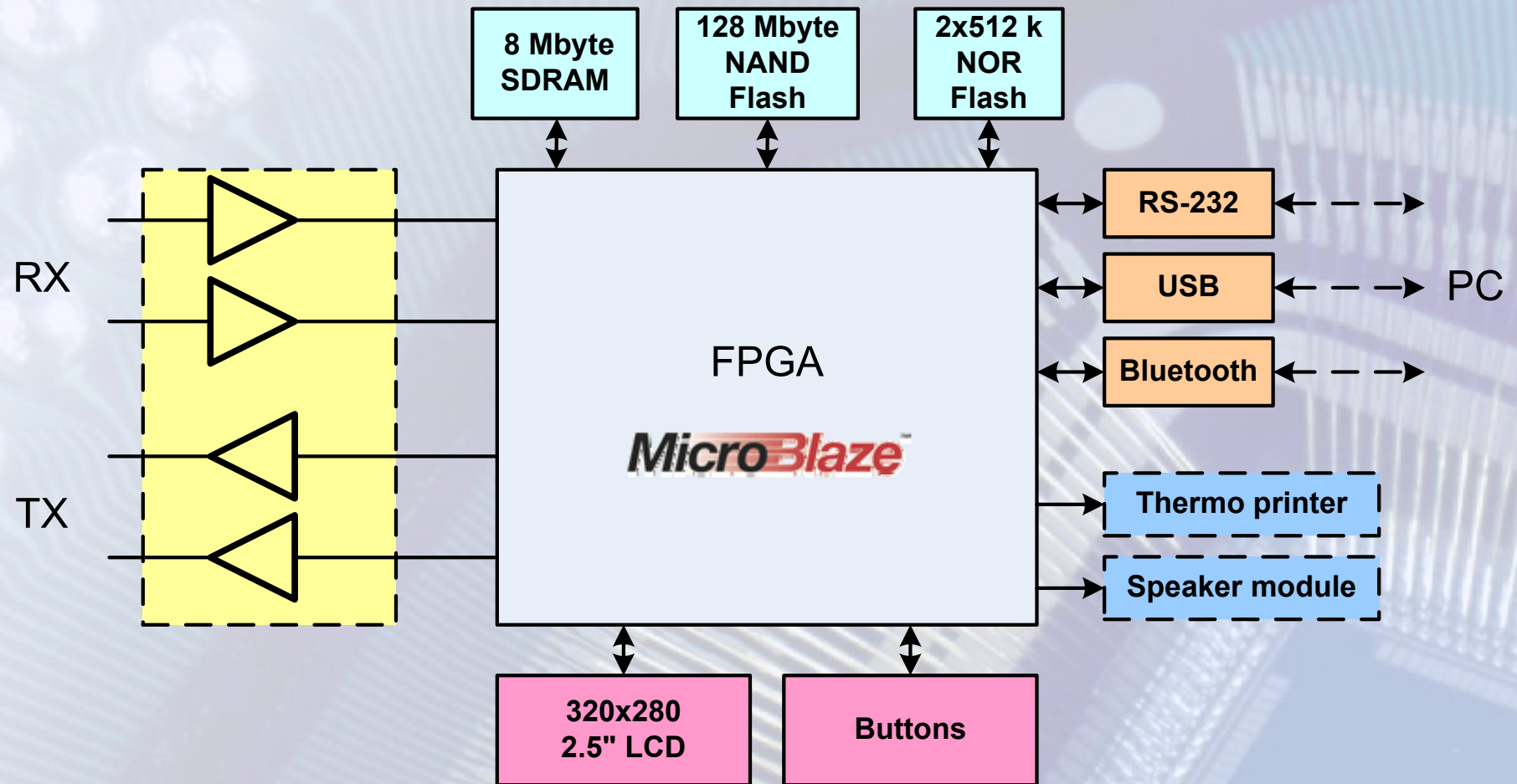
- 4 x Virtex-5 FPGA (\$2000)
- 16 x DDR2 memória
- Nagysebességű összeköttetés
- 4 x PCI Express (x8) csatlakozó
- 4 x QSH-DP (LVDS) csatlakozó
- 8 x 10 GBit/s-es CX-4 Interfész
- 4x 1 GBit/s Ethernet

Spirothor

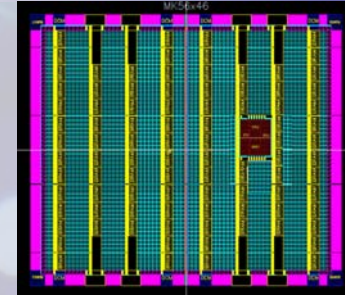
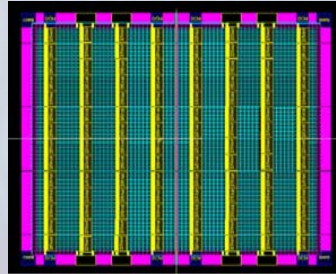


- Spartan 3 FPGA
- SDRAM
- NAND Flash
- NOR Flash
- 3 UART
- Áramlásmérő IF
- **uC Linux**

Na jó, de mi van benne?



Xilinx SoPC processzor típusok



	Szintetizálható	„Kemény” mag
Példa	MicroBlaze™	PowerPC™
Alkalmazható FPGA-k	   	 
Sebesség	~100 Mhz	~300 Mhz

Az építőkövek: Periféria IP-k

Ingyenes

Időzítő



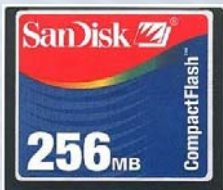
Általános célú I/O

Egyszerű UART



Memóriavezérlők

- SDRAM, DDR
- SRAM, Flash
- SytemAce



Kipróbálásra beépíthető

Ethernet

Gigabit Ethernet

16C550 UART

PCI híd

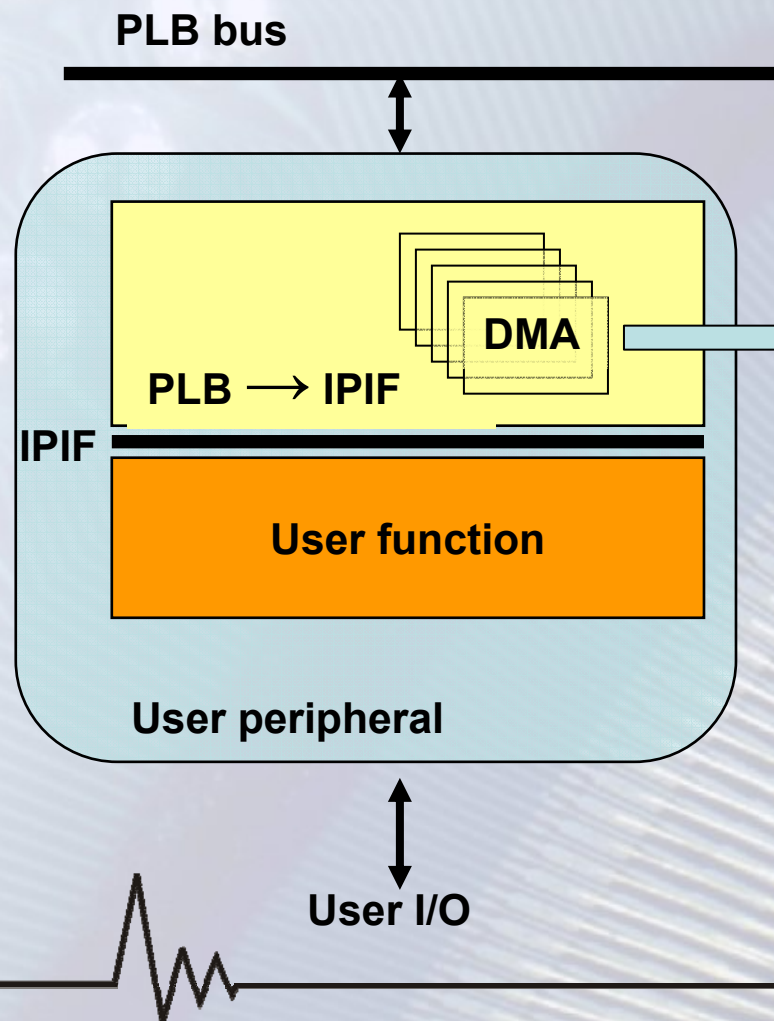


Fizetős (Xilinx, külső IP)

Saját

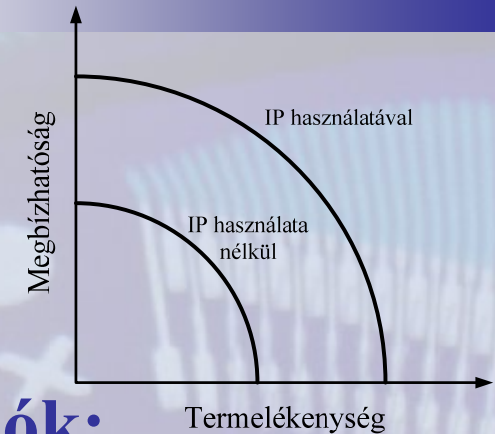
Saját IP létrehozása

A perifériák felépítése:



Beépített funkciók:

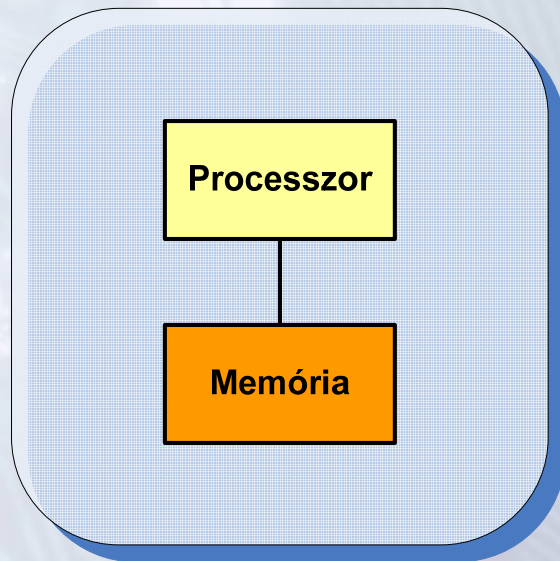
- DMA
- Megszakítás
- Burst
- FIFO
- Master
- Cím tartomány dekóder



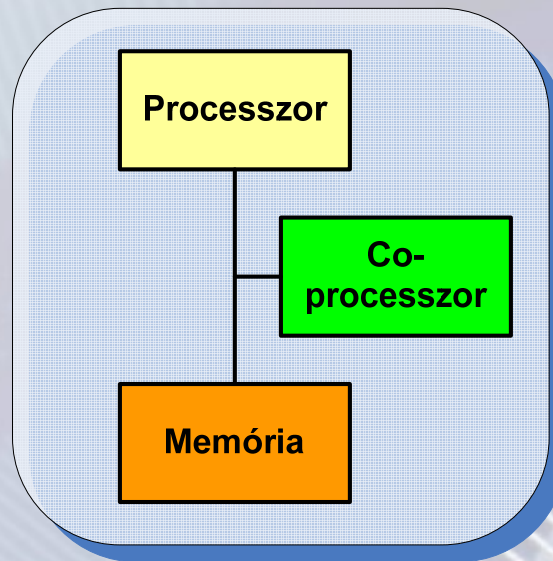
A tervezés menete



Utastás kiterjesztés – Co-processor

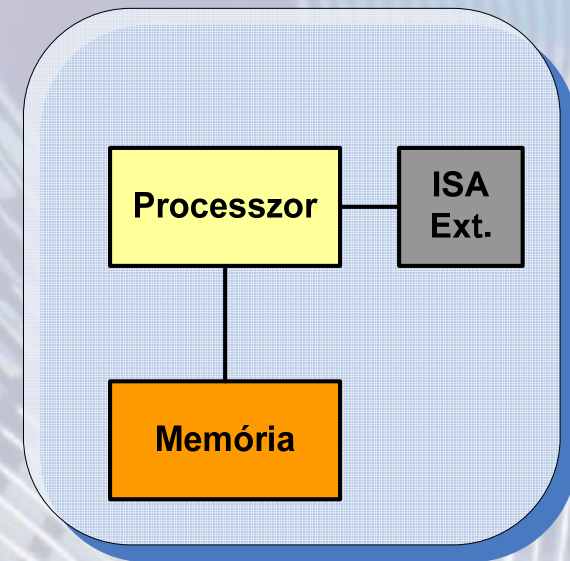


Hagyományos



Co-processor

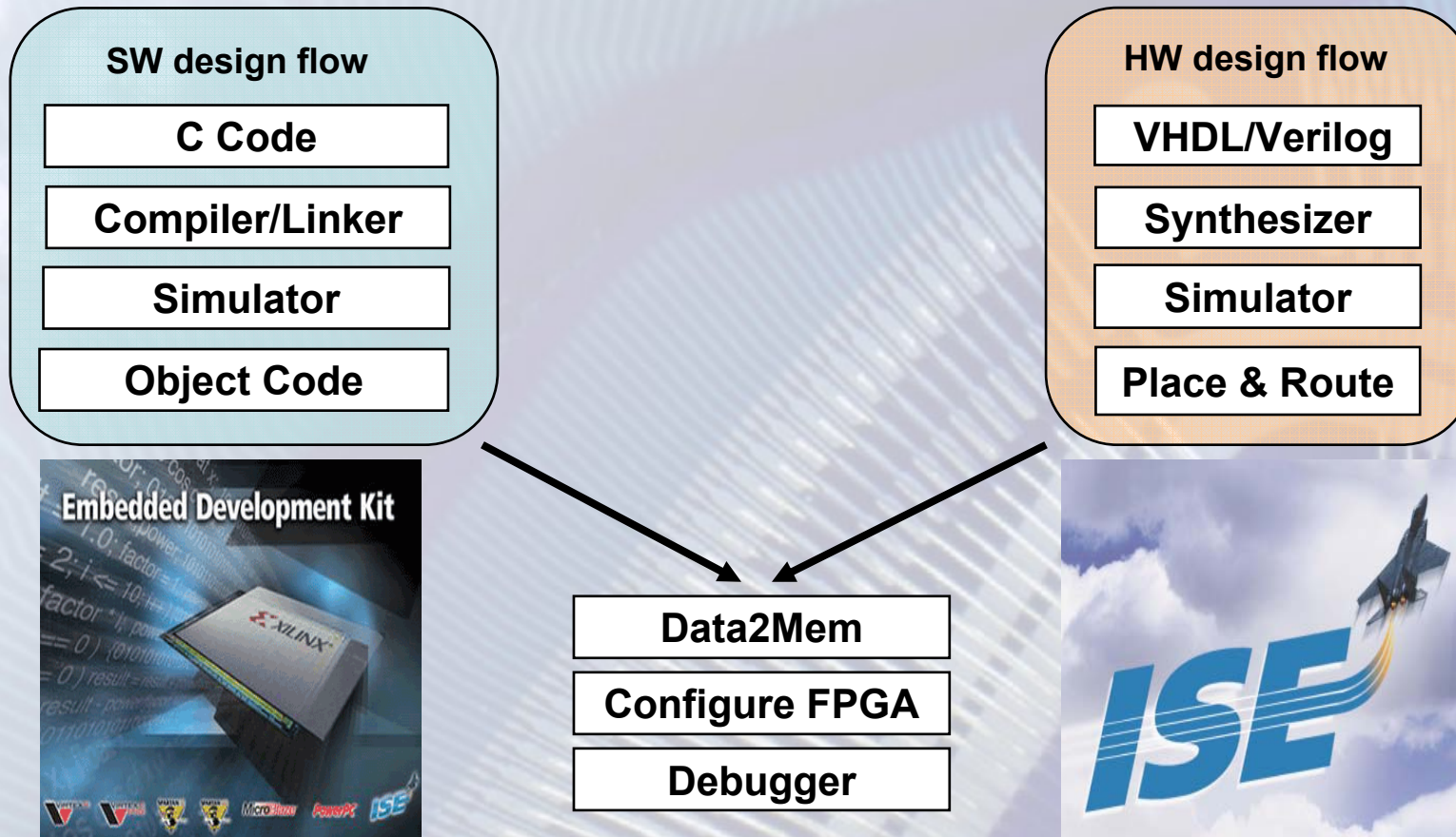
DCT mag
DES kódoló



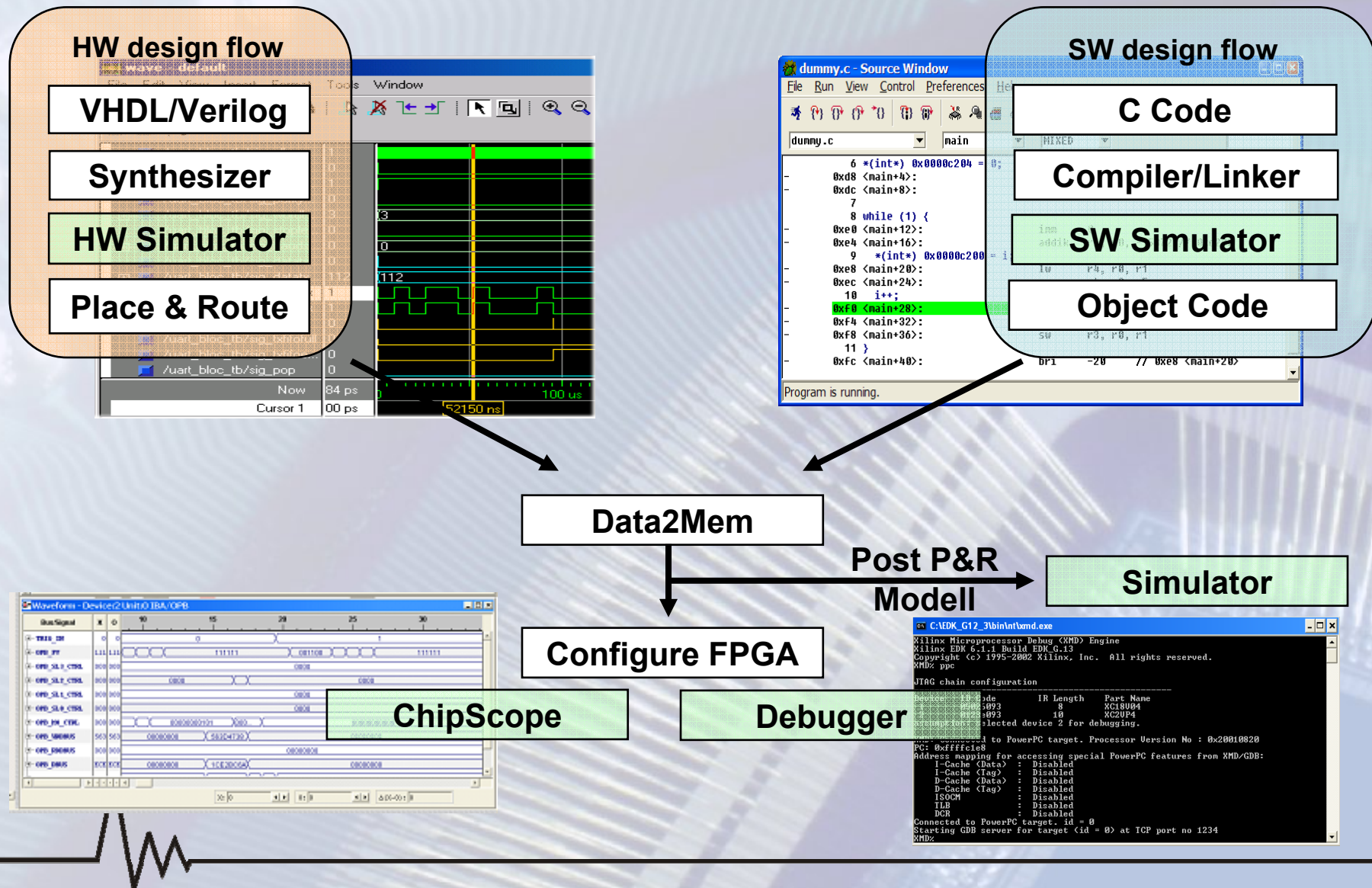
**Utastás
kiterjesztés**

Lebegőpontos ALU

Tervezési folyamat áttekintése



Fejlesztési-ellenőrzési lehetőségek



HW/SW együttes fejlesztés-bemérés

GDB forrás ablak
- SW töréspont

```
dummy.c - Source Window
File Run View Control Preferences Help
Unit: 0 IBA/OPB 0xF0 10
dummy.c main MIXED
6 *(int*) 0x0000c204 = 0;
7
8 while (1) {
9     *(int*) 0x0000c200 = i;
10    i++;
11 }
12
13 Program is running.
```

ChipScope Pro mérés
- HW töréspont

ChipScope Pro Analyzer [system]

Project: system

Unit: 0 IBA/OPB

Match Unit	Function	Value	Radix	Counter
M0:TRIG0: OPB_CTRL		X_XXXX_XXXX_XXXX_XXXX	Bin	exactly one clock cycle
M1:TRIG1: OPB_ABUS		0000_c200	Hex	exactly one clock cycle
M2:TRIG2: OPB_DBUS		0000_0005	Hex	exactly one clock cycle
M3:TRIG3: OPB_RDOBUS		XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX	Bin	exactly one clock cycle
M4:TRIG4: OPB_WROBUS		XXXX_XXXX_XXXX_XXXX_XXXX_XXXX_XXXX	Bin	exactly one clock cycle
M5:TRIG5: OPB_M0_CTRL		XXXX_XXXX_XXXX	Bin	exactly one clock cycle
M6:TRIG6: OPB_SL0_CTRL		XXXX	Bin	exactly one clock cycle
M7:TRIG7: OPB_SL1_CTRL		XXXX	Bin	exactly one clock cycle
M8:TRIG8: OPB_SL2_CTRL		XXXX	Bin	exactly one clock cycle
M9:TRIG9: OPB_SL3_CTRL		XXXX	Bin	exactly one clock cycle
M10:TRIG10: OPB_PV		XX_XXXX	Bin	exactly one clock cycle
M11:TRIG11: TRIG_IN		X	Bin	exactly one clock cycle

Waveform - Device:2 Unit:0 IBA/OPB

Bus/Signal	X	O
TRIG_IN	0	0
OPB_PV	111 111	1111111 001100 1111111
OPB_SL3_CTRL	00000000	0000
OPB_SL2_CTRL	00000000	0000
OPB_SL1_CTRL	00000000	0000
OPB_SL0_CTRL	00000000	0000
OPB_M0_CTRL	000000000101	000 000000000000
OPB_WROBUS	563 563	00000000 50304730 00000000
OPB_RDOBUS	00000000	00000000
OPB_DBUS	ECE:ECE	00000000 1CE78C6A 00000000

COMMAND: run 2 0
COMMAND: upload 2 0
INFO: Device 2 Unit 0: Sample Buffer is full

Egységes esemény kezelés !

Köszönöm a figyelmet!

BME
i'm lovin' it



Kalendárium



2002

2003

2004

2005

2006

2007

2008

2009



Doktori

MIT

JÁP