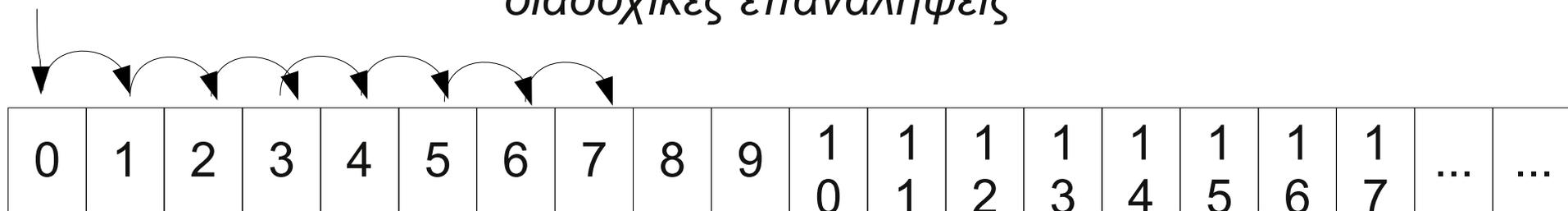


CPU

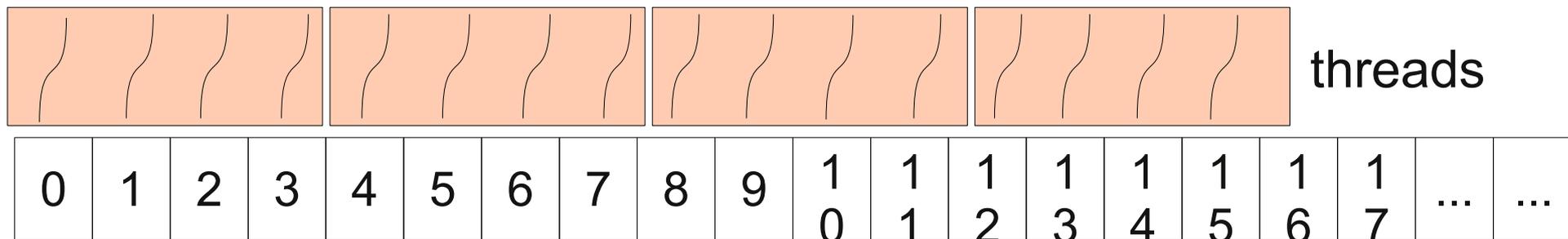
διαδοχικές επαναλήψεις



GPU

ταυτόχρονα

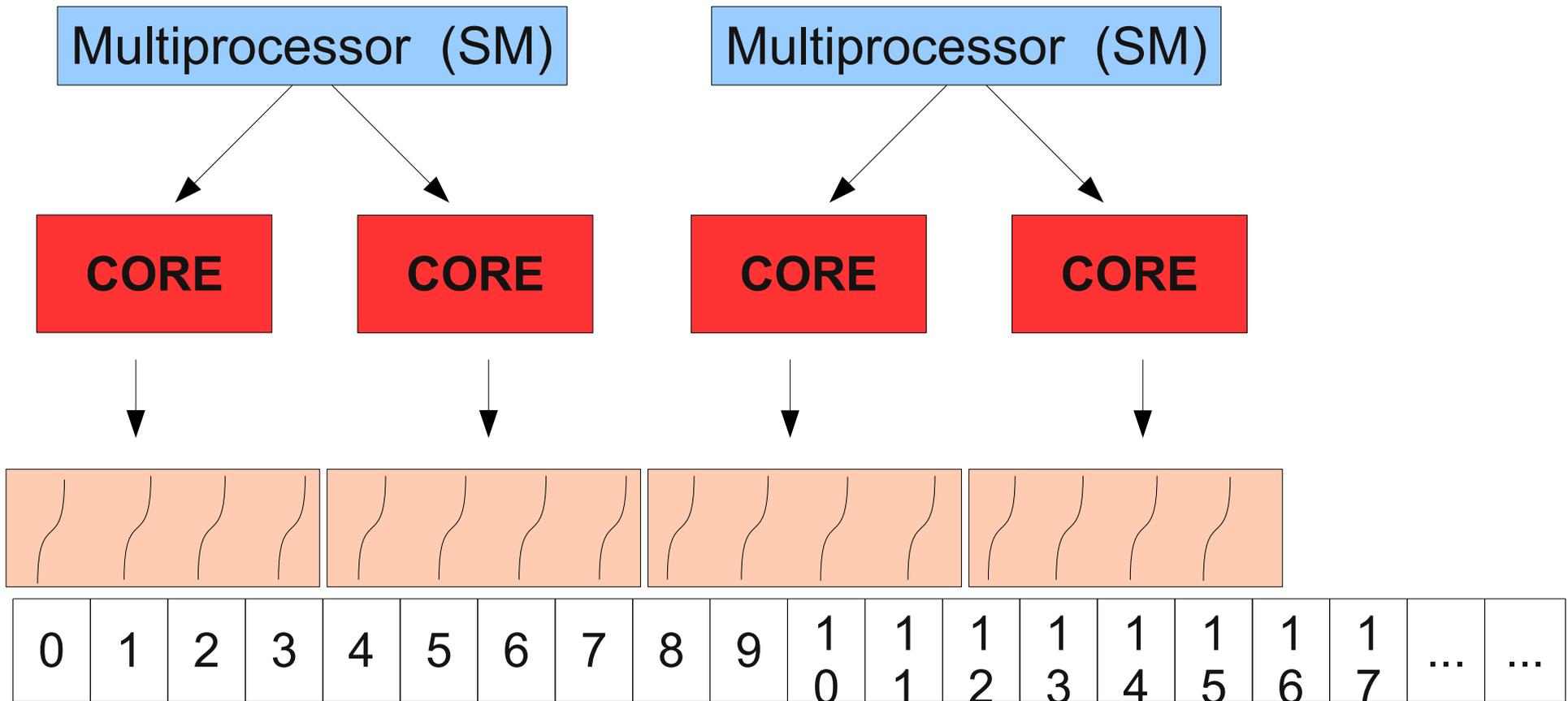
blocks



έχω 768 threads... και πίνακα 1024 στοιχείων (???)

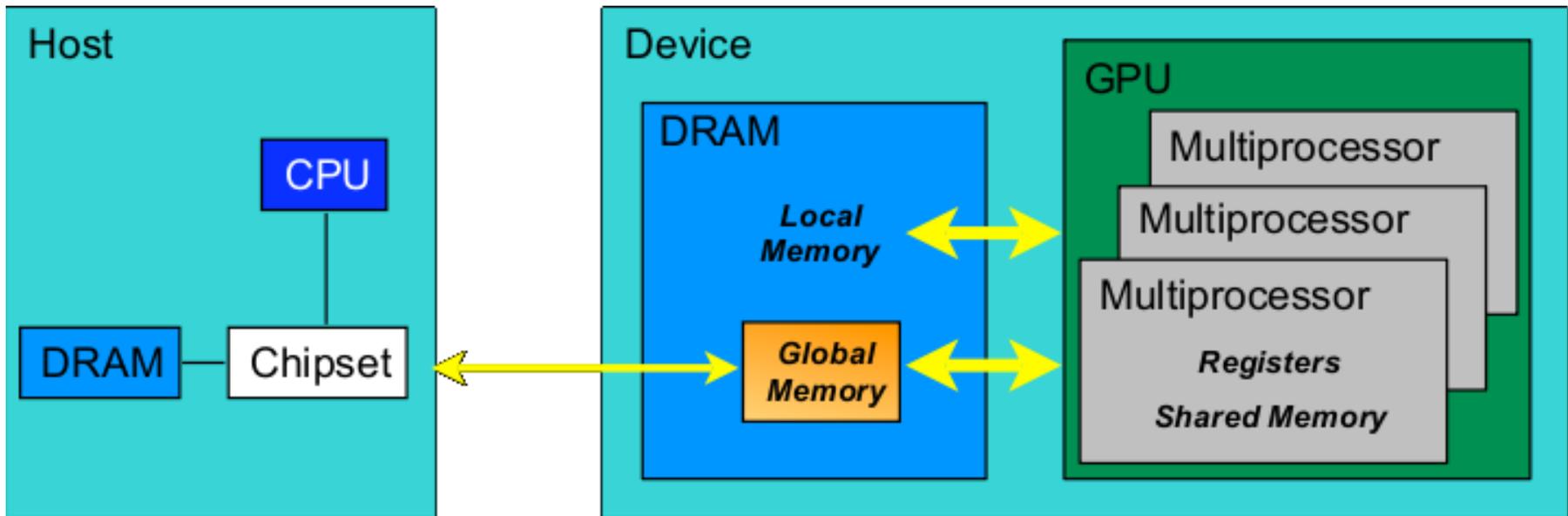
GPU

(ή έχω περισσότερα - scalability)



χωρίς να επηρεάζεται καθόλου ο κώδικας

Χωριστές οντότητες



“Σύστημα”

“Συσκευή”

Χωριστές μνήμες και προσβάσεις σε αυτές

Υλοποίηση ??? → kernel

Kernel

kernel <<<gridDM,blockDM>>> (.....)

Συνάρτηση τύπου `__global__`

- τύπου `void`
- απαγορεύεται μεταβλητός αριθμός μεταβλητών
- δεν μπορεί να καλεί τον εαυτό του
- μπορεί να καλεί συναρτήσεις τύπου `__device__`
- όχι `static` μεταβλητές

Kernel

ορισμός:

```
__global__ void kernel (.....)
```

κλήση:

```
kernel <<<gridsize,blocksize>>> (.....)
```

“execution configuration”

```
dim3 gridsize, blocksize;
```

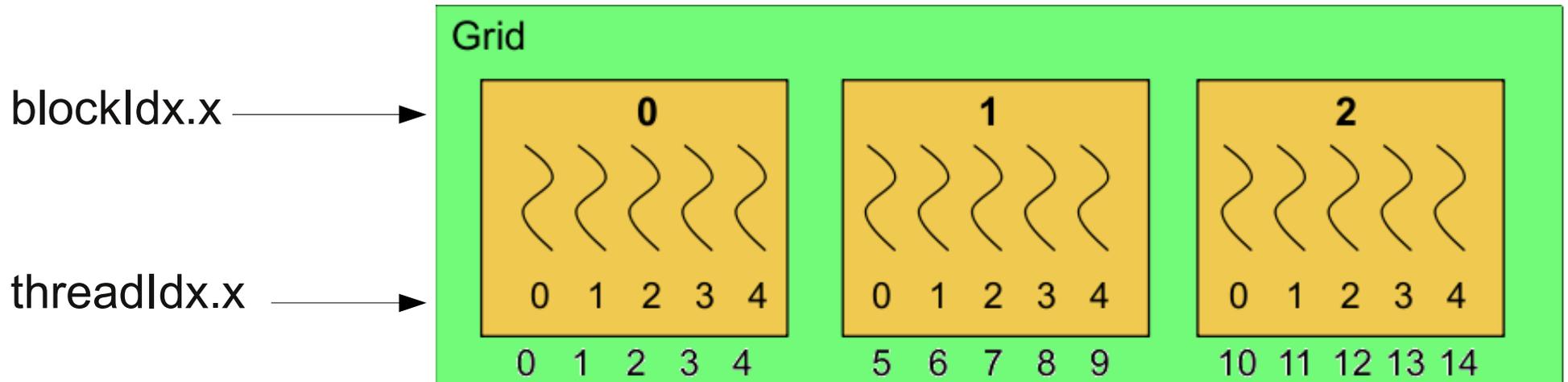
```
gridsize.x = 3 ; gridsize.y = 6 ;
```

```
blocksize.x = 4 ; blocksize.y = 7; blocksize.z = 9;
```

grid έως 2d

block έως 3D

Kernel



```
__global__ void kernel (int* a, int* b, int* c) {  
    idx = blockIdx.x * blockDim.x + threadIdx.x ;  
  
    a[idx] = blockIdx.x;  
    b[idx] = threadIdx.x;  
    c[idx] = blockIdx.x * blockDim.x + threadIdx.x ;  
}
```

```
kernel <<<3,5>>> (.....);
```

εΠΙΚΟΙΝΩΝΙΑ Device - Host

- `cudaMalloc(void ** pointer, size_t nbytes)`
- `cudaMemset(void * pointer, int value, size_t count)`
- `cudaFree(void* pointer)`

```
int nbytes = n*sizeof(int);  
int *dev_a = 0;  
cudaMalloc( (void**)&dev_a, nbytes );  
cudaMemset( dev_a, 0, nbytes);  
cudaFree(a_d);
```

```
cudaMemcpy(void *dst, void *src, size_t nbytes, enum  
            cudaMemcpyKind direction);
```

- cudaMemcpyKind:
 - cudaMemcpyHostToDevice
 - cudaMemcpyDeviceToHost
 - cudaMemcpyDeviceToDevice

--παραδείγματα κώδικα--

occupancy calculator

Συγχρονισμοί:

Η ροή της εκτέλεσης στο σύστημα:

- Οι kernels εκτελούνται ασύγχρονα
- Η `cudaMemcpy()` εκτελείται “σύγχρονα”
- `cudaThreadSynchronize()`

Η ροή της εκτέλεσης στη συσκευή:

- `sync` όλου του `grid` δεν γίνεται! (αλλά πως;)
- `sync` όλου του `block` γίνεται: `__syncthreads();`

www.nvidia.com/cuda -> developers -> downloads

εκπαιδευτικό υλικό:

http://developer.nvidia.com/object/cuda_training.html

forums:

<http://forums.nvidia.com>

<http://www.eclipse.org/> -> downloads -> eclipse IDE for C/C++ dev.....

cuda plugin για το eclipse:

<http://www.ai3.uni-bayreuth.de/> -> software -> eclipse toolchain for compiling CUDA & QT

προσθήκη της cudart library στο eclipse....

project -> properties -> ...

The image shows a 'Settings' dialog box in an IDE. On the left is a tree view of settings categories. The 'Settings' category is selected. The right pane shows the 'C++ Linker' settings, with the 'Libraries' sub-section selected. It contains two lists: 'Libraries (-l)' with 'cudart' and 'Library search path (-L)' with '/usr/local/cuda/lib64'. Buttons for 'Cancel' and 'OK' are at the bottom right.

type filter text

- Resource
- Builders
- ▼ C/C++ Build
 - Build Variables
 - Discovery Options
 - Environment
 - Settings**
 - Tool Chain Editor
- ▼ C/C++ General
 - Code Style
 - Documentation
 - File Types
 - Indexer
 - Language Mappings
 - Paths and Symbols
- Project References
- Refactoring History
- Run/Debug Settings
- ▶ Task Repository
- WikiText

Settings

- Debugging
- Warnings
- Miscellaneous
- ▼ C Compiler
 - Preprocessor
 - Symbols
 - Directories
 - Optimization
 - Debugging
 - Warnings
 - Miscellaneous
- ▼ CUDA NVCC Compiler
 - Preprocessor
 - Includes
 - Flags
- ▼ C++ Linker
 - General
 - Libraries**
 - Miscellaneous
 - Shared Library Settings

Libraries (-l)

- cudart

Library search path (-L)

- /usr/local/cuda/lib64

Cancel OK

Περιορισμός των regs/thread στο eclipse

The screenshot shows the Eclipse IDE Settings dialog for the CUDA NVCC Compiler. The left sidebar shows the 'Settings' category selected under 'C/C++ Build'. The main panel shows the 'CUDA NVCC Compiler' settings. The 'Command' field is set to 'nvcc -c --maxrregcount=16'. The 'Expert settings' section shows a 'Command line pattern' field with the text '\${command} \${flags} \${output_flag} \${oi}'. The 'All options' field is empty.

εδώ μπαίνουν και όποιες ρυθμίσεις του compiler