System Compilation for MPSoC based on NoC

Ahmed A. Jerraya
CEA-LETI
Ahmed.jerraya@cea.fr

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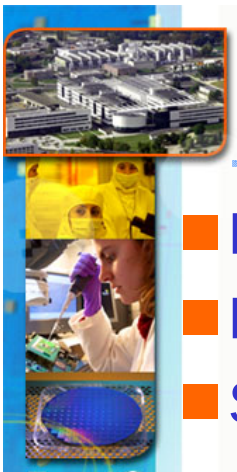
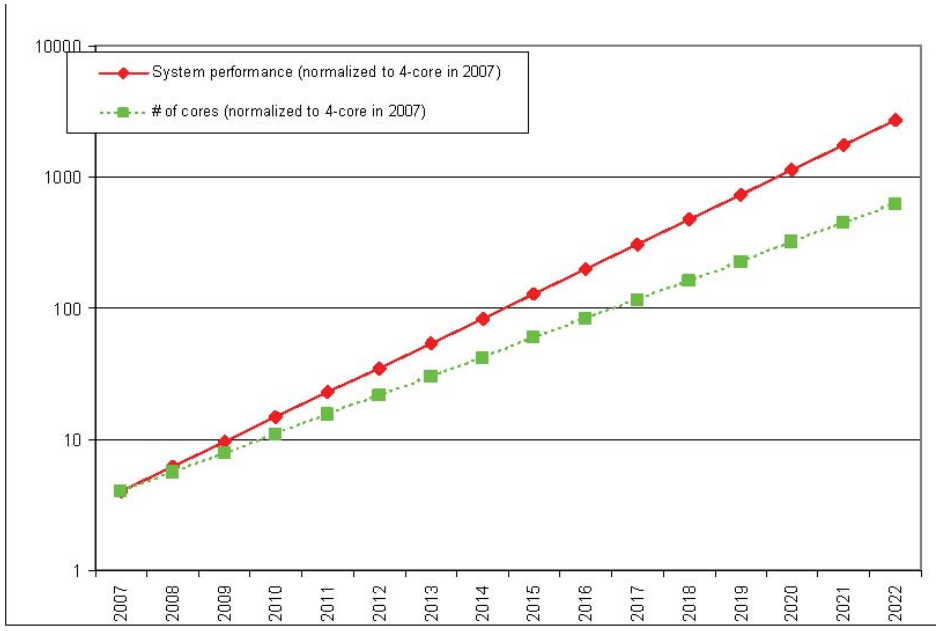


Outline

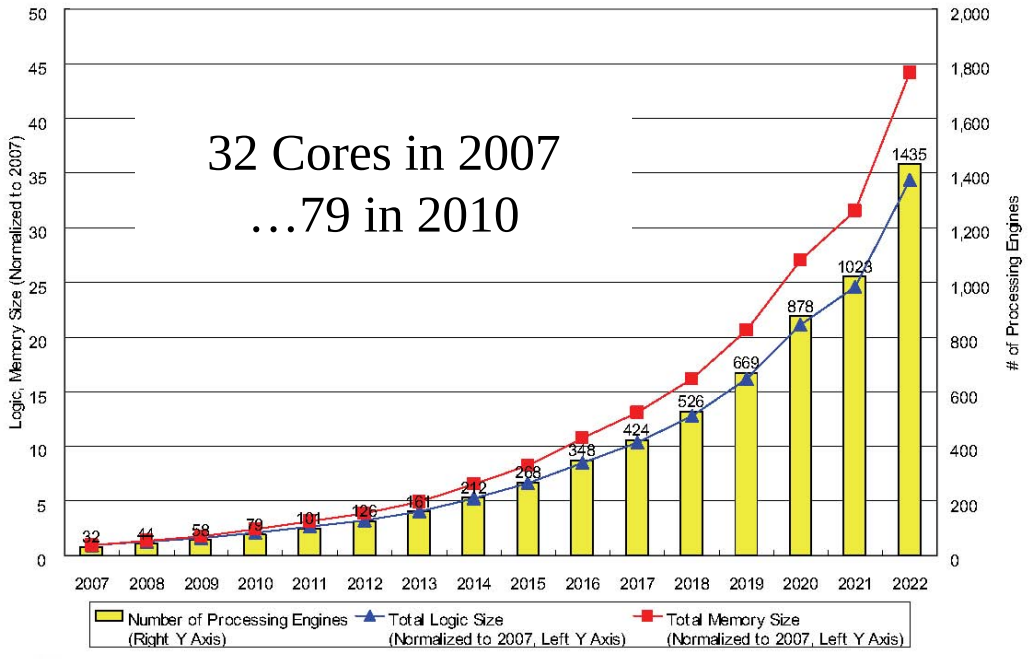
- MPSoC Based on NoC
- NoC and Programming models
- System Compilation for NoC.

SOC Networking Driver Trends [ITRS]

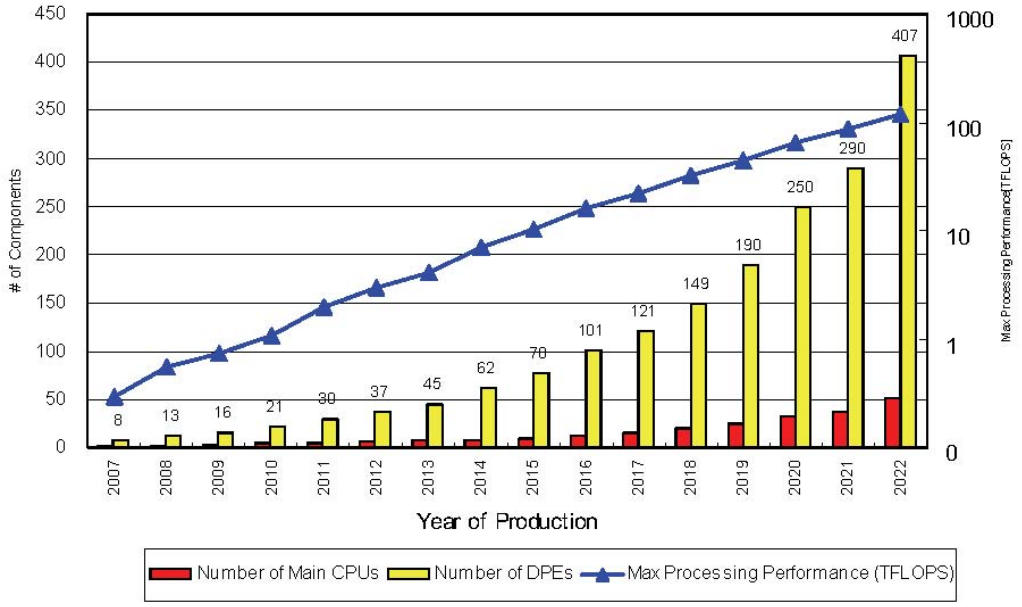


4 Cores in 2007, 10 in 2010 and 100 in 2016

SOC Consumer Portable Design Complexity Trends [ITRS]



SOC Consumer Stationary Design Complexity Trends [ITRS]

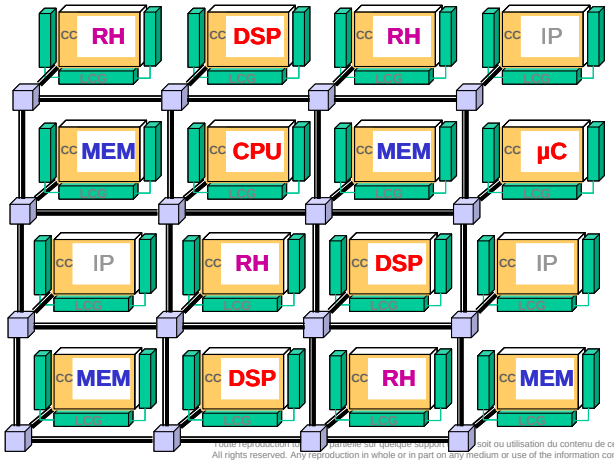


Correspondence Between System-Level Design Requirements and Solutions [ITRS]

Requirement	*Solution*
Design block reuse	System-level component reuse
	On-chip network design methods
Available platforms environments	Multi-fabric implementation planning (AMS, RF, MEMS, …)
Platforms supported	Automated interface synthesis
	Automated HW-SW co-design and -verification
Accuracy of high level estimates	Improved system-level power -estimation techniques
	Chip-package co-design methods
SOC reconfigurability	On-chip network design methods
Analog automation	Multi-fabric implementation planning (AMS, RF, MEMS, …)
Modeling methodology, description languages, simulationenvironments	Mixed-Signal/RF verification

What is an MPSoC based on NoC?

- "NoC is an interconnection structure for exchanging information on a chip between heterogeneous or homogeneous HW/SW resources"



NoC Research world-wide

×PIPES, Stanford&Bologna Univ.

Best Effort NoC
SPIDERGON, STM
PROTEO, Tampere Univ.
DSPIN, LIP6

NoC with QoS
ÆTHEREAL, Philips
NOSTRUM, KTH
FAUST, LETI

Asynchronous NoC
HERMES, PUCRS
CHAIN, UK

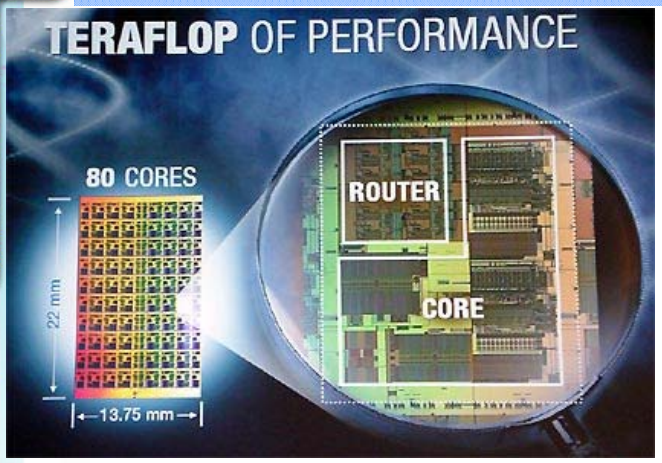
NoC on FPGA
GECKO, IMEC

NoC start-up
SILISTIX, UK
ARTERIS, FR
INOCS, CH

Industrial products
TILERA, US
PICOCHIP, US
TERAFLOP, US
Sonics, US

- **More than 60 projects**
  - Universities and Industries
- **Convergent Technique choices**
  - 2-D topology
  - Deterministic routing
  - Packet commutation

Intel's TERAFLOP



80 floating-point cores
NoC packet switching
65nm
275 mm2
1.28TFLOPS
4GHz
98W

- An impressive realization…
- But : what about application mapping on such a platform ?

Outline

- MPSoC Based on NoC
- **NoC and Programming models**
- System Compilation for NoC.

NoC and programming model

- Programming model
  - "An abstract conceptual view of the structure and operation of a computing system"
  - A set of mechanisms (hardware and/or software) to help an application to map on an underlying system

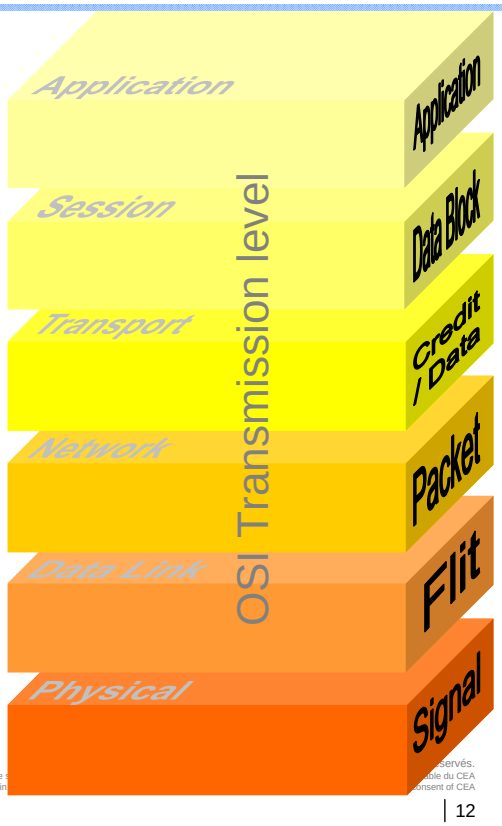
⇒ A link between the application and the system

⇒ Fields of research: application description, programming languages, compilers, libraries, communication systems, I/O

Programming NoC = Configure Protocol Stack

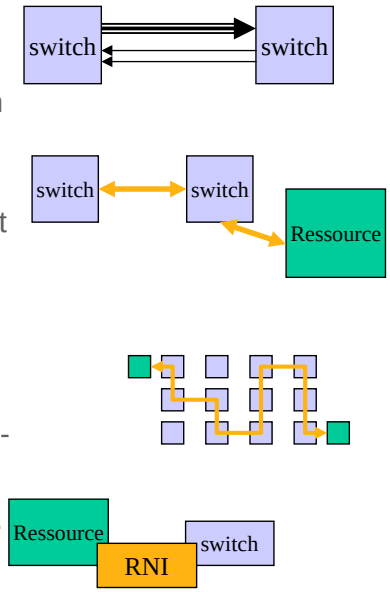
Programming model of the NoC-based platform is essential. It can determine :

- **Reconfiguration management**
- **Task synchronization**
- **Power management**
- **Bandwidth allocation**
- **End-to-end flow control**
- **Protocol wrappers**
- **Packet routing**
- **GALS strategy**

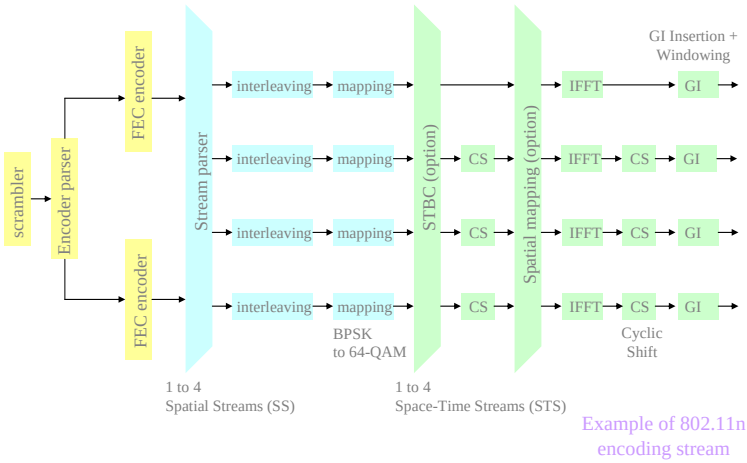


SW code and Configuration Parameters for HW Layers

- SW Code is generated for the upper layers
- Configuration parameters are generated for the layers implemented in HW, generally the four lower layers of the OSI reference model
  - **Physical layer**: determines the number and length of wires connecting resources and switches. Unit of communication: electrical signal
  - **Data link layer**: defines a protocol to transmit information between entities (switch, resource). It may include flow control and error correction. Unit : bits and words
  - **Network layer**: defines how data are transmitted over the network from an sender to a receiver (routing algorithm) Unit : packet, flit
  - **Transport layer**: establishes and maintains end-to-end connections. Its performs packet segmentation and reassembly and ensure message ordering (Resource Network Interface). Unit : message



Application complexity: 802.11n (wifi)



Example of 802.11n encoding stream

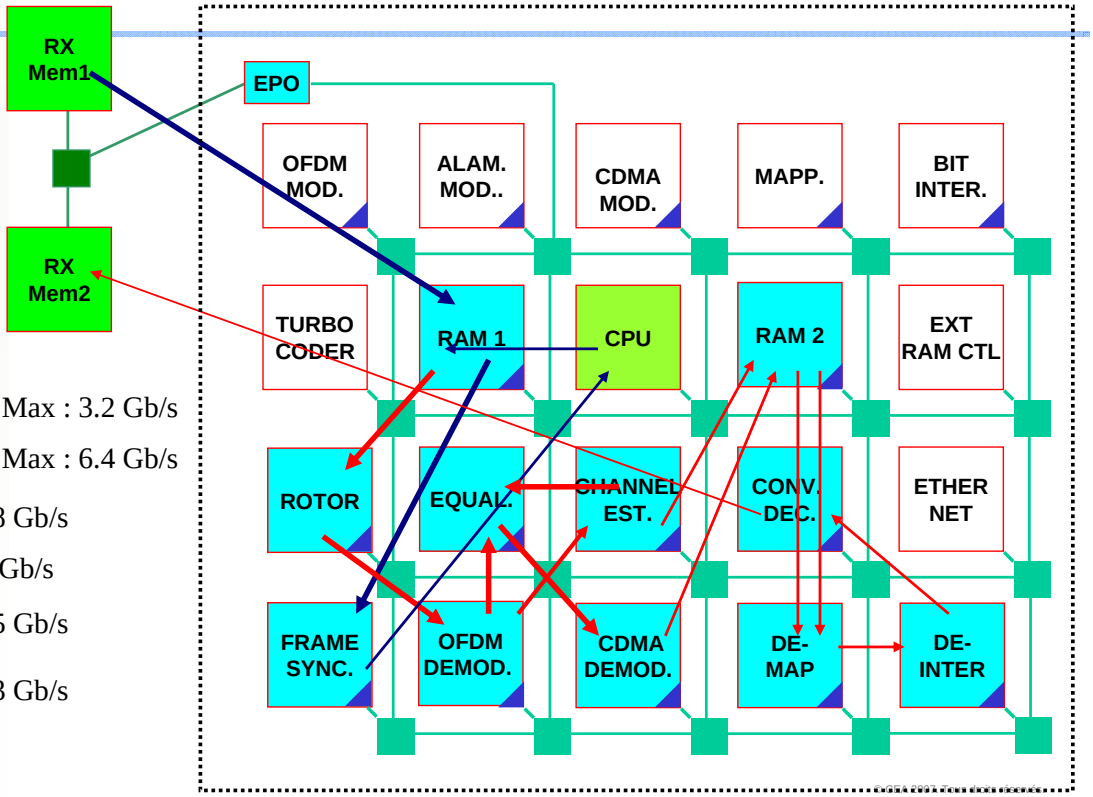
802.11n

144 communications modes

2 potential coding streams, 1 to 4 antennas

1 to 4 spatial streams 1 to 4 space-time streams

Application Example Traffic (RX)



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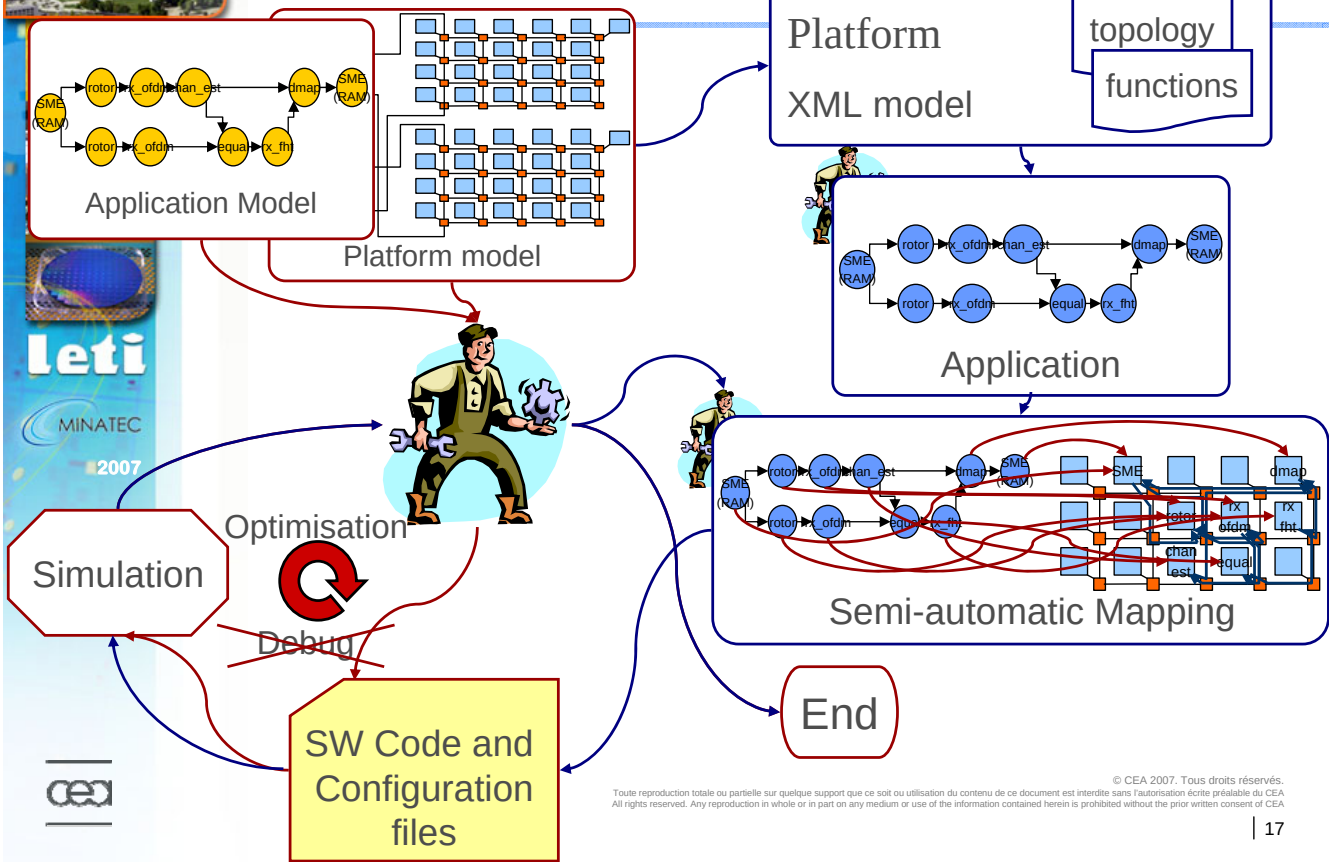
- **System Compilation for NoC.**

System compilation for MPSoC/NoC [Leti08]



Many thanks

- LETI's team
  - F. Clermidy, P.Vivet, E. Beigné, Y. Thonnart, R. Lemaire

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