FROM RESEARCH TO INDUSTRY

cea tech

Ultra Low Power and low cost Asynchronous Service Network Architecture for Adaptive Blocks Reconfiguration in an IoT Wireless Sensor Node Circuit

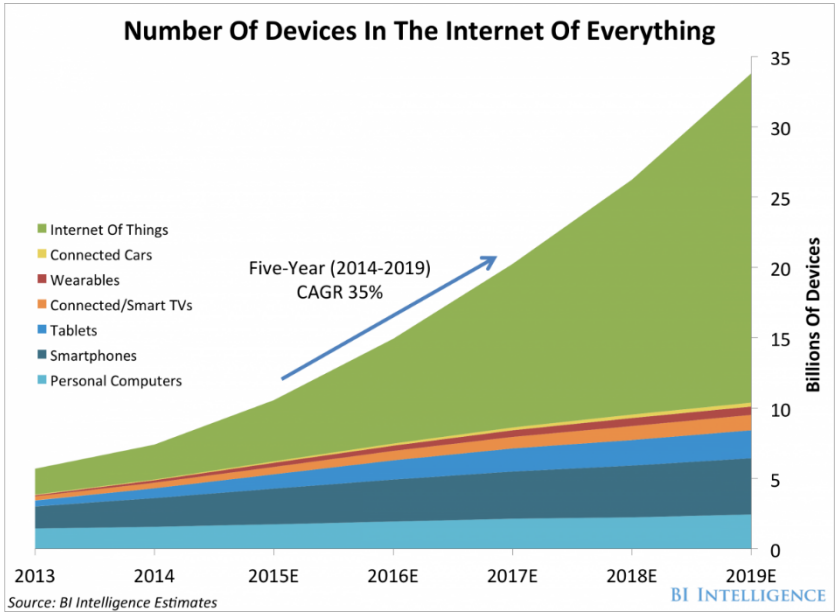
ASYNC 2016

Chairat Soundous, Edith Beigné, Ivan Miro-Panades, Florent Berthier, Marc Belleville

www.cea.fr

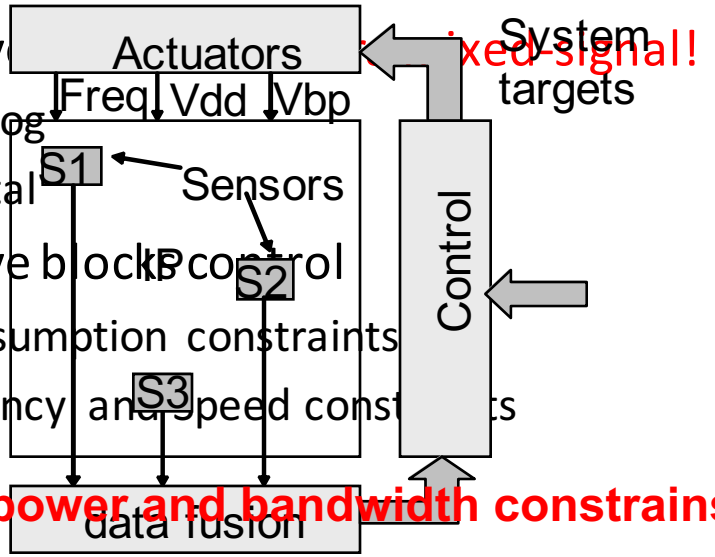
leti & list

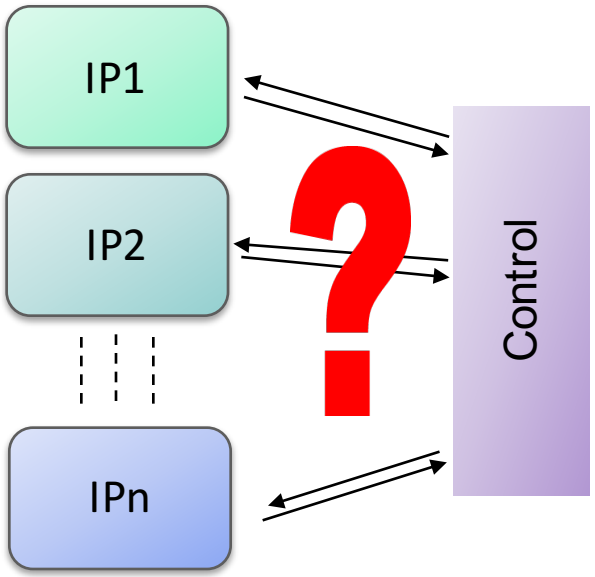
- **30 to 50 billions** of smart-objects by 2020 (The Economist & BI)
- Many applications to address **new challenges**
  - 70 % of the World's population in cities by 2050 ➡ **smart-building & transport**
  - 33 % of the World's population over 65 years old by 2050 ➡ **smart-health**
- Why **low-power** ?
  - Global Energy Impact
  - Convenience (all-day battery life)
  - Small form factor (in-body implants)
  - Maintenance-free (wide deployment)



Adaptativity for Low Energy in WSN

- Low power in WSN is an important system requirement
- Adaptativity in WSN for low energy
  - Tracking the Optimum Energy Point
  - Adaptativity to on-going application requirements
  - Adaptativity to on-going environment
- Adaptive blocks control
  - Adaptiv… ixed-signal!
    - Analog
    - Digital
  - Adaptive block… control
    - Consumption constraints
    - Latency and speed const…ts





Different latency, power and bandwidth constrains What interconnection network ?

SoA: usual communication networks

	Bus	Topology	Frame		Arbitration
			Data_bus	Address_bus	
CoreConnect	PLB	Hierarchical bus	32/64/128/256	32	Priority
	OPB	Hierarchical bus	32	32	Priority
	DCR	Daisy chain	32	10	Priority
AMBA	AHB	Hierarchical bus	32/64/128/256	32	Application dependent
	APB	Hierarchical bus	32/64/128/256	32	X

- AMBA (ARM)
  - Frame adapted for large data
- CoreConnect:
  - DCR: used for configuration purposes
  - Can only reconfigure digital blocks

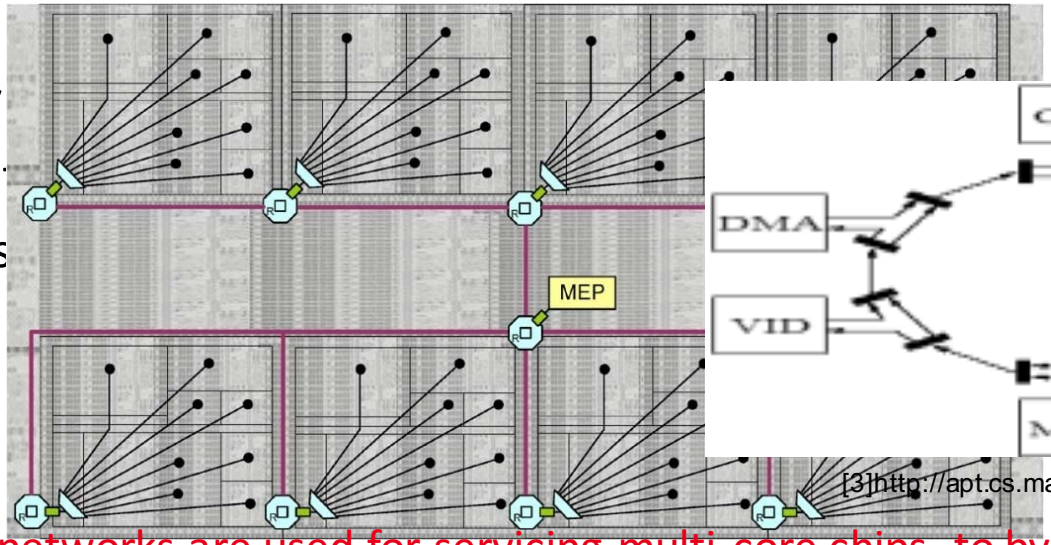
Problem: networks designed for multi-core communication

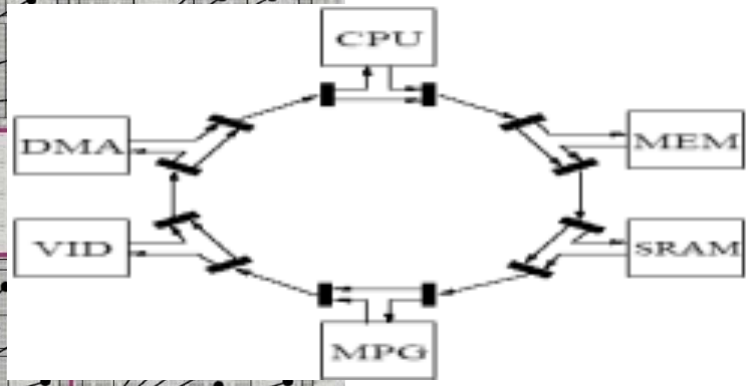
- Too high of a throughput
- DCR is oversized

SoA : dedicated service/control network

- MNoC (Monitoring Network on Chip)
  - Packetization of data into flits => routing thanks to LUTs => depacketisation
  - Use of 2 channels: priority and normal channel

- CHAIN
  - Delay
  - Use o
  - High s



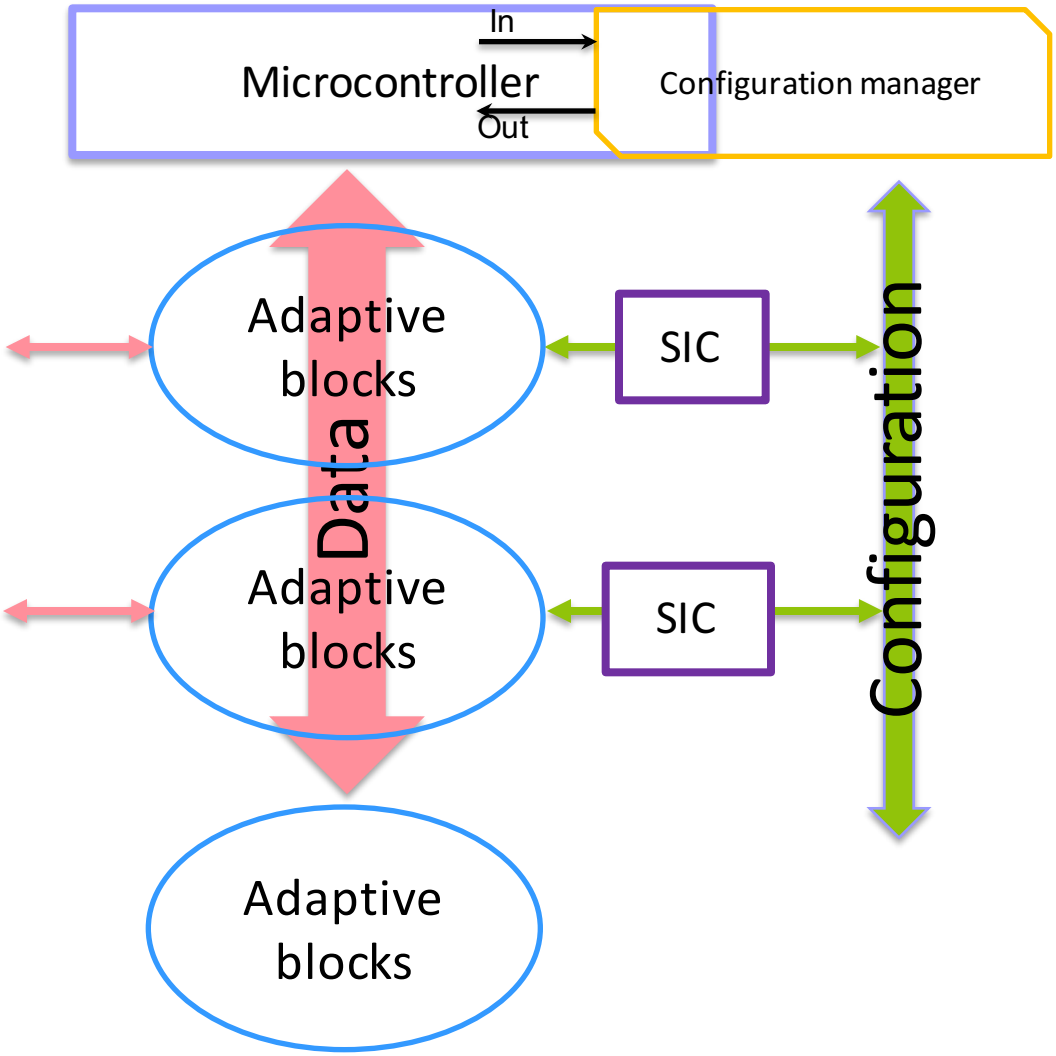


[3]http://apt.cs.manchester.ac.uk/projects/interconnect/

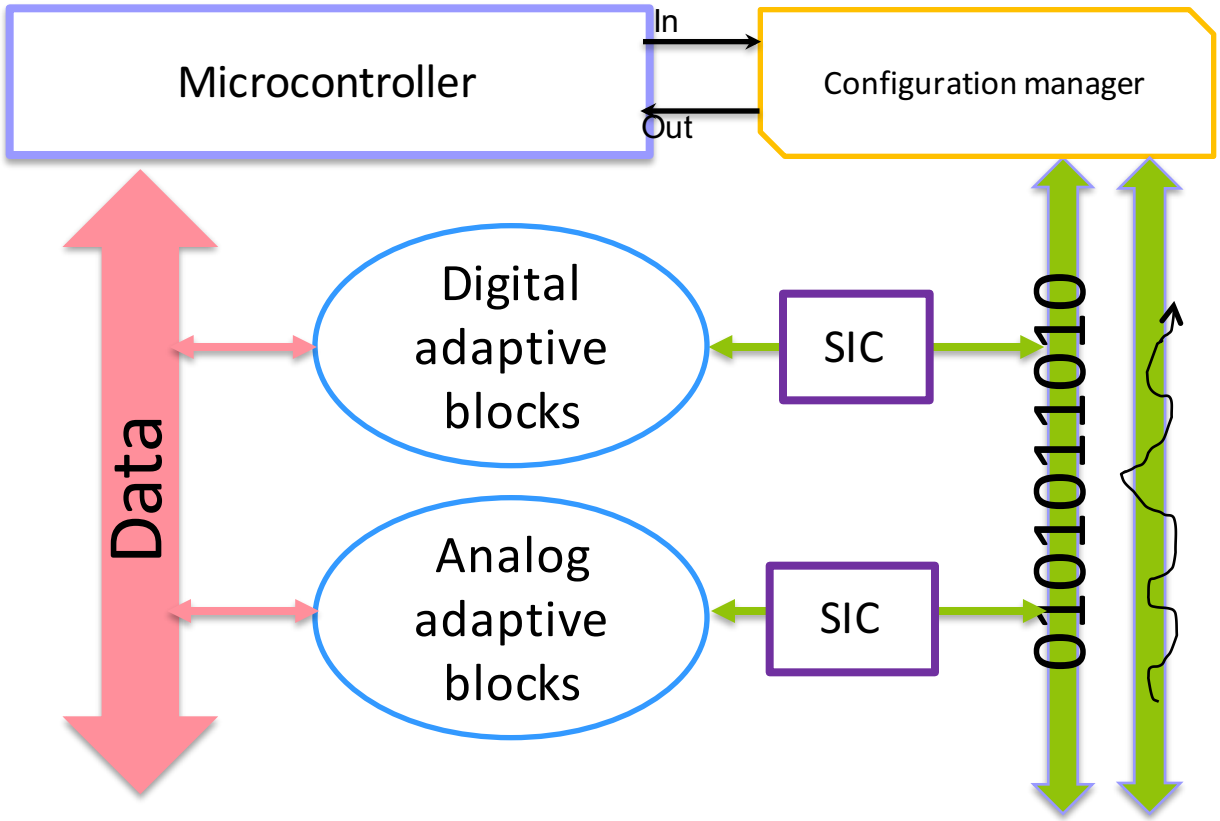
Problem: these networks are used for servicing multi-core chips, to bypass latency problems, or to target specific applications

[2]Madduri,S. DATE 2009

Service Network Basics

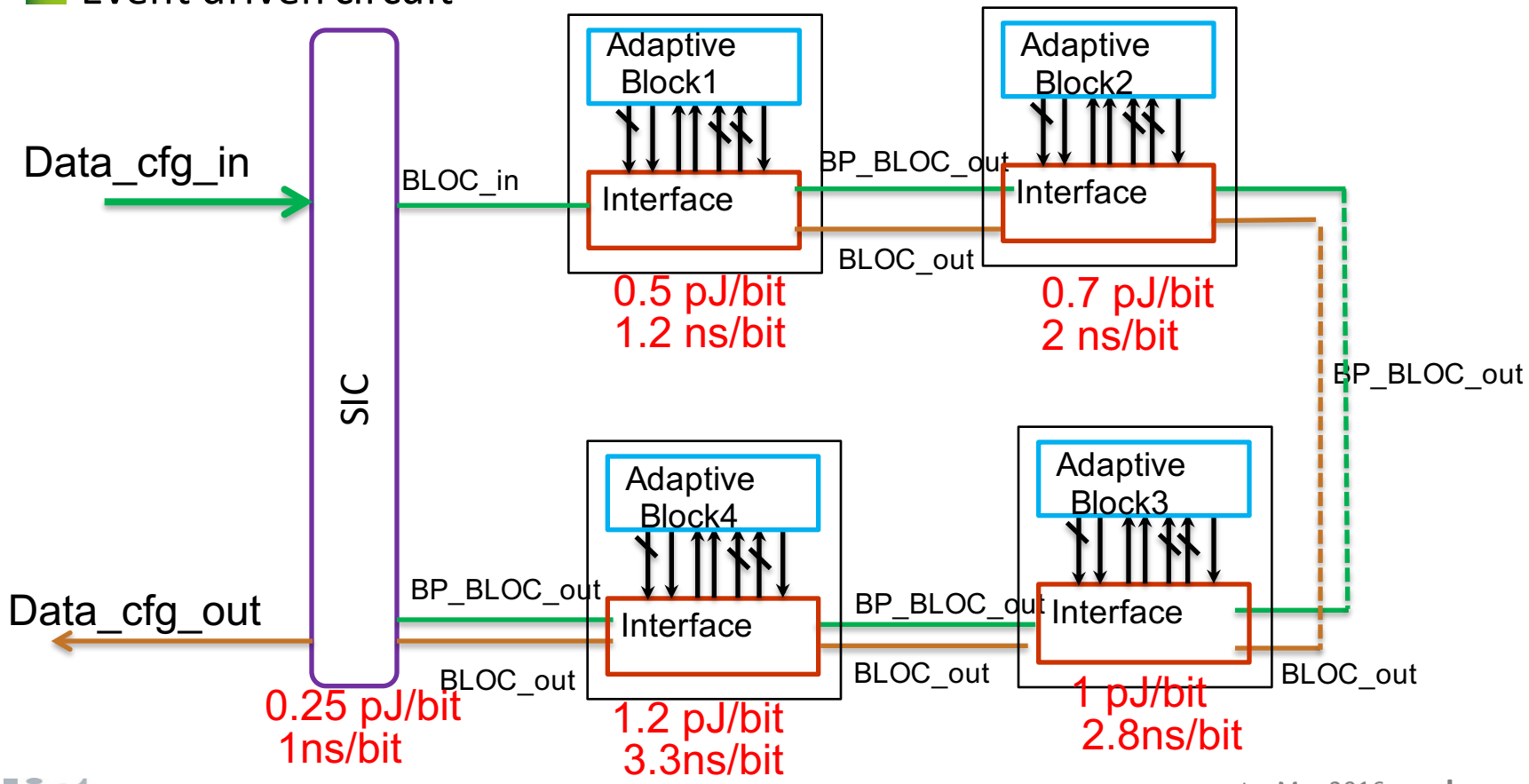


Fresh Ideas : an evolution for IoT WSN



First implem: digital configuration

- Asynchronous QDI logic
  - Robustness
  - Quick wake up
  - Event driven circuit
- Network
  - Serial Interface Controller
  - Interface



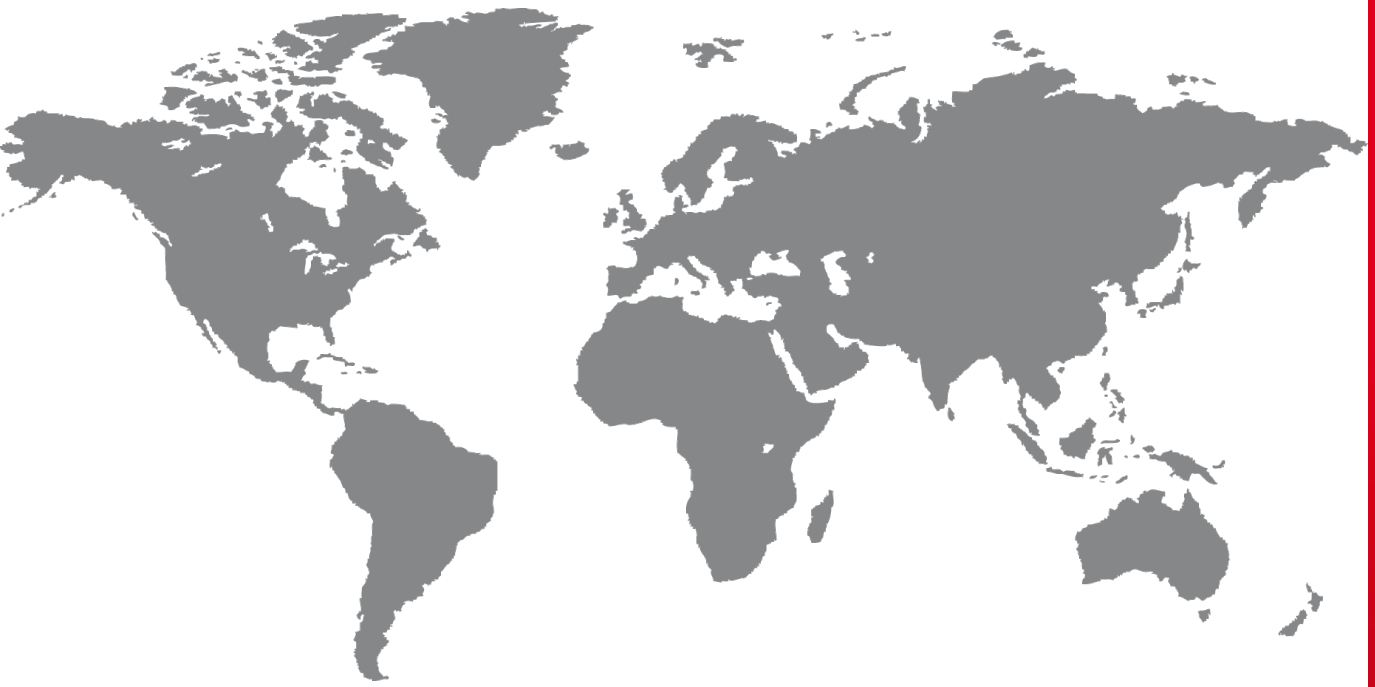
Conclusion & perspectives

Conclusion

- Reconfiguration network for adaptive blocks in a WSN node circuit
  - **Not only for digital blocks (usual) but also for analog blocks**
- Asynchronous logic implementation
- Low cost and low energy network
- Reconfiguration of Frequency Locked Loop as example

Perspectives

- Digital configuration hardware implementation and fabrication
- Analog Block reconfiguration mechanisms



Thank you

soundous.chairat@cea.fr

INSTITUT CARNOT CEA LETI

INSTITUT CARNOT CEA LIST

MINATEC

digiteo

leti
Centre de Grenoble
17 rue des Martyrs
38054 Grenoble Cedex

list
Centre de Saclay
Nano-Innov PC 172
91191 Gif sur Yvette Cedex