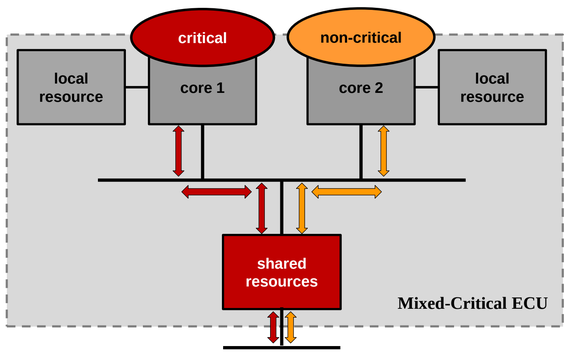
WP3 Dynamic Runtime Environments and Services
IDAMC Integrated Dependable Architecture for Many Cores

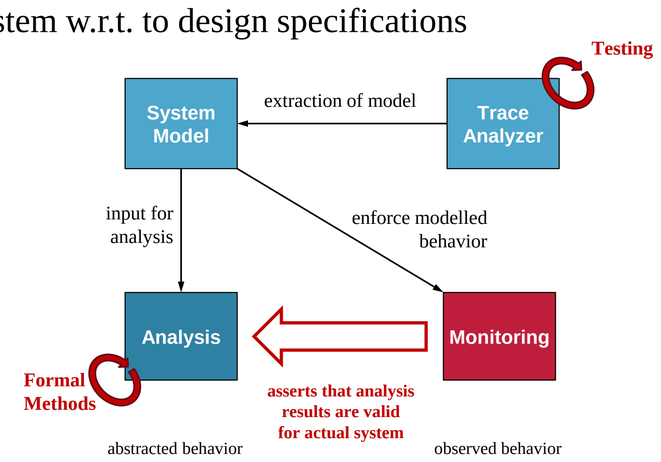
Multicore Systems

- Arriving to **safety-critical systems** (e.g. automotive, avionic …)
- Integration of functionalities from previously distributed ECUs
- Applications of different criticalities sharing resources
- Shared resources can degrade performance and safety
- Challenges:
  - **Functional independence** but allow communication
  - **Timing independence** but efficient scheduling



Monitoring

- **Observe** and **validate** behavior of system w.r.t. to design specifications
- Can be passive or active
- Passive:
  - Only observe and report
- Active:
  - Interact with the system under observation

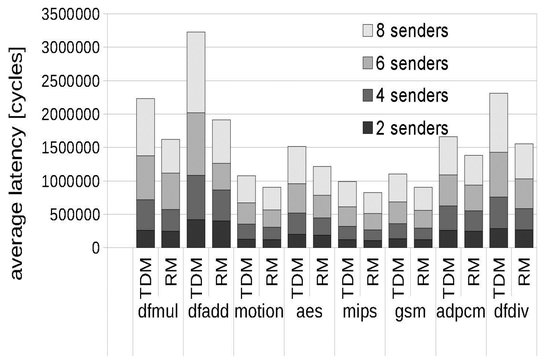


Resource Brokering

- Additional **control layer** enabling distributed, hybrid or centralized **admission control**
- Enables **dynamic adaption** to runtime behavior
- Transparent for applications
- Hardware independent (can use COTS HW)

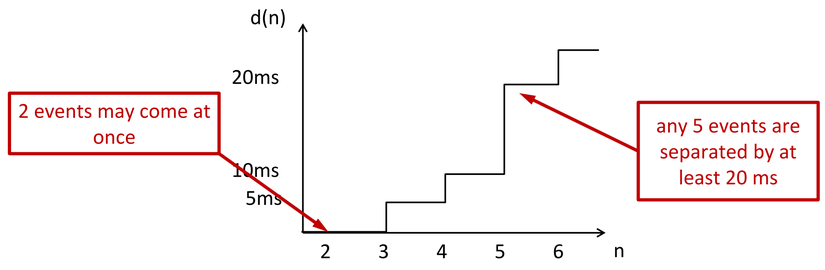
Benefits:

- Dynamic budgeting
- Reduced overprovisioning
- **Safe and efficient** resource sharing
  - Enables better worst-case guarantees and performance than TDM



Monitoring Arbitrary Activation Patterns

- Monitoring of the minimum distance between any n consecutive events (n-repetitive minimum distance function)



- Benefits:
  - **Better flexibility** compared to standard (periodic) approaches
  - **Good scalability** (linear increase of computational time and memory usage)
  - User/specified trade-off between accuracy and overhead (runtime & memory)
  - Many possible applications (CPU, Network, Peripherals)

Brokering Research

Time-Division Multiplexing

- Entire NoC handled as a single shared resource
- Each application/transmission has a time slot
- Accesses granted in a cyclic order
- Advantage: permits isolation
- Disadvantage: introduces a static, periodic, non-work conserving scheme

→ decreased utilization whenever the system is not highly loaded

Non-blocking routers with rate control

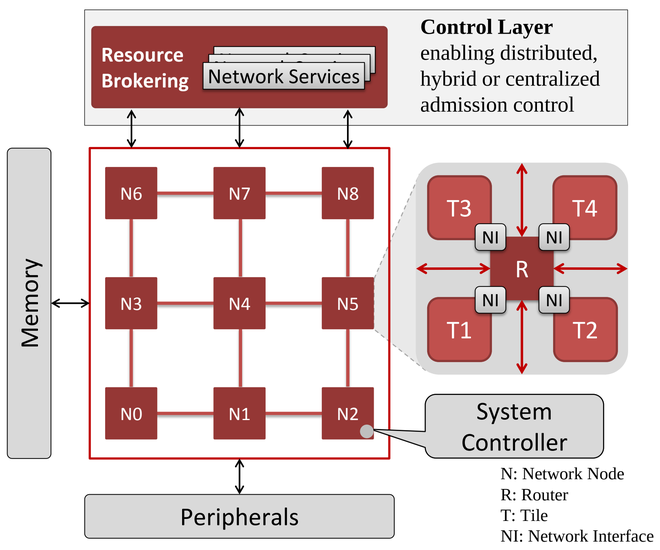
- Local arbitration performed independently in routers
  - Transmissions separated on independent virtual channels
  - No correlation between routers, i.e. a blocked packet cannot block arriving packets
- Advantage: work-conserving scheduling and isolation
- Disadvantage: high hardware overhead

Resource Brokering

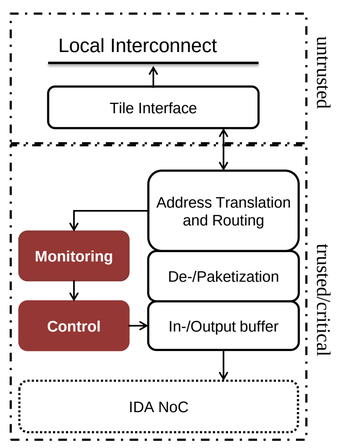
- Offers worst-case guarantees
- Reducing hardware overhead
  - Sharing of a virtual channel
- Reducing head-of-line blocking
- Reducing temporal overhead
  - Global work-conserving scheduling

Development Platform

- Integrated Dependable Architecture for Many Cores (IDAMC)
- 4-64 nodes (N)
- Mesh Network-on-Chip
- Up to four tiles (T) per node
- Hardware mechanisms for
  - Virtualization and Isolation
  - On-chip data transport Monitoring (timing and power)

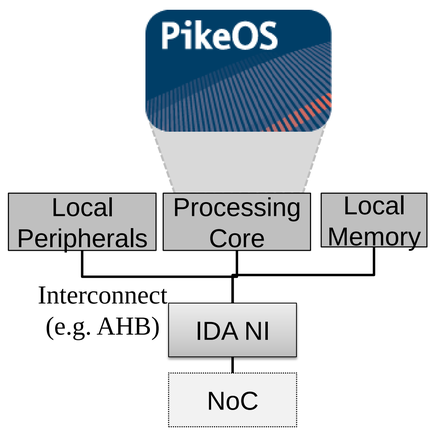


IDAMC Network on Chip



IDAMC Network Interface

- Based on Gaisler's GRLIB IP library (LEON3 processor, AMBA 2.0, …)
  - Heterogeneous tiles possible
- Extended by **network interface (NI)** as AHB master and/or slave
- Other local busses might be supported in the future by the use of wrappers (e.g. OCP)
- NoC and others tiles are accessible via memory range of NI
- Support for **PikeOS**



Simple Tile Design

Contributing Partners:

Technische Universität Braunschweig

SYSGO EMBEDDING INNOVATIONS

ARTEMIS