

HPCDD 2016

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Villetaneuse, France

Applying Distributed Computing Techniques to The Parametric Verification of Real-Time Systems

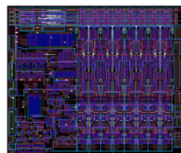
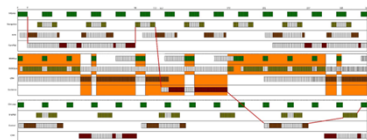
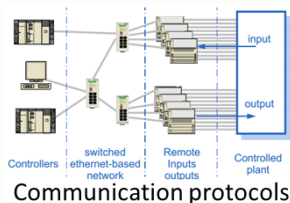
Hoang Gia Nguyen

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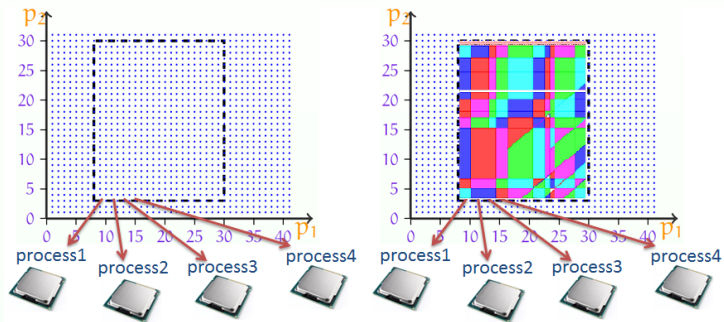
Context: Formal Verification of Timed Systems

Parametric timed automata, a formalism to model and verify concurrent real-time systems [Alur et al., 1993]



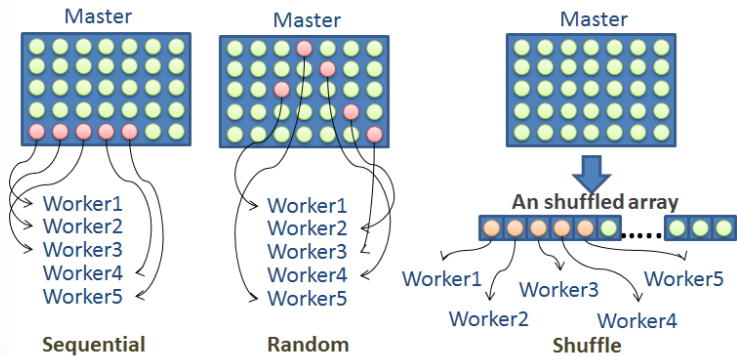
One procedure for verifying such that systems is Behavioral Cartography BC.

Distributing BC



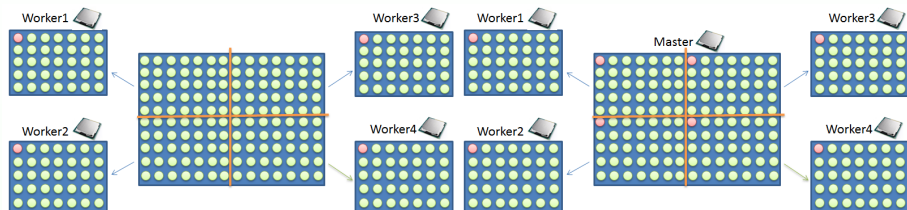
- BC: is the algorithm, by iterative calls from integer points, it partition an n -dimension parameter space into subdomains of same behavior.
- Problem: BC is very slow! (up to several hours)
- Goal: distribute BC on a cluster to increase the computation speed

Point-based BC Algorithms



- 1 Sequential:** Each point is sent to a worker **sequentially**
- 2 Random:** Points selected **randomly**, then switches to **Sequential**
- 3 Shuffle:** Similar to the **Sequential**, but the master must **statically compute** the array of all points, then **shuffle all points**, then store them back in array (**new**)

Domain-based BC Algorithms



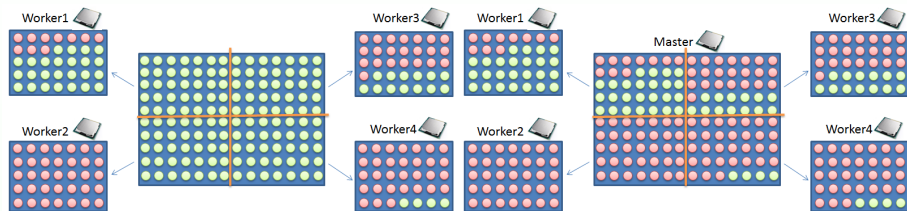
Static:

- One of **Workers** splits the domain then sends to other workers and gathers result of all workers
- **Drawback:** computing time depends on the slowest process

Dynamic:

- **Master** is only responsible for **gathering results** and **splitting domain/sub-domains**
- Master monitors all Workers then it can **balance workload (by splitting)** between workers

Domain-based BC Algorithms



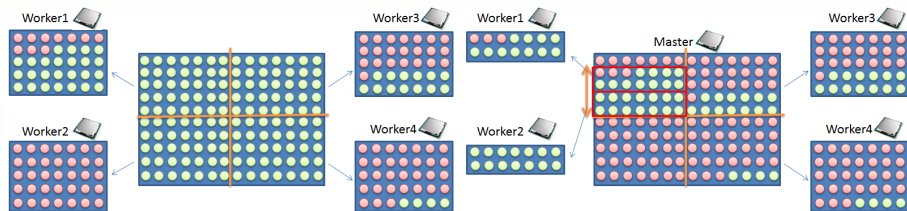
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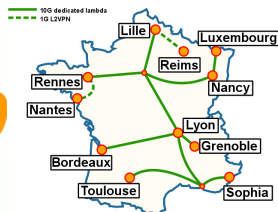
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Experimental Validation




Experimental conducted on a 2 clusters of Grid'5000:


- 1 **Pastel**(Located in **Toulouse**, FR): 140 nodes
- 2 **Griffon**(Located in **Nancy**, FR): 92 nodes


Each node's	Pastel	Griffon
Processors	2x Dual-core AMD Opteron 2218@2.6GHz	2x Quad-core Intel Xeon L5420@2.5GHz
Memory (GB)	8	16
Interconnection network	GigaEthernet	GigaEthernet + 20G InfiniBand


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