



Metropolis: An Integrated Electronic System Design Environment

Felice Balarin, Vosinori Watanabe,
Harry Hsieh, Luciano Lavagno Claudio
Passerone,
Alberto Sangiovanni-Vincentelli

1/24/2004

1



Outline

- Design overview
- Related tools and the need for an integrated platform
- Metropolis METAMODEL
- Tools in Metropolis

1/24/2004

2



Design Overview

- Integrated tools needed for system-level design
- Manually linking unlinked tools doesn't preserve the design's semantics
- Metropolis seeks to provide a unified framework to support designs

1/24/2004

3



Related Research and Tools

- Cadence Design System's Virtual Component Codesign (VCC)
 - separation between functionality and architecture
 - fixed computation model
 - uses C and C++ to define the behaviors of processes, rules out formal process analysis
- Other tools from Arexsys, Foresight, Artisan, and CardTools

1/24/2004

4



Metropolis: Design Activity(1)

- First design activity: communication of design intent and results
 - Interactions among people
 - Among different abstraction levels
 - Concurrently at the same abstraction level

1/24/2004

5



Metropolis: Design Activity(2)

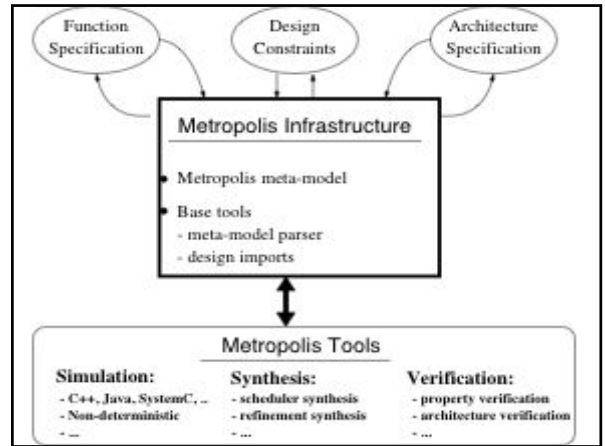
- Second design activity: analysis through simulation and formal verification
 - Verify the implementation satisfying requirements
 - Abstraction can be used to reduce the complexity.

1/24/2004

6

Metropolis: Design Activity(3)

- Third design activity: synthesis, throughout the abstraction levels used in a design.
 - Setting the parameters of architectural elements
 - designing scheduling algorithm and interface block
 - Synthesis of the final implementations in hardware and software



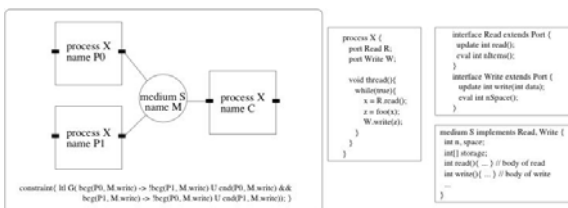
Metropolis Metamodel

- Metamodel: a language to specify networks of concurrent objects
 - formally defines a network's behavior by the language's execution semantics.
 - represents all the key ingredients in the design flows

Function modeling

- processes communicate through medium
 - separation computation with communication
- thread execution as a sequential program
- support nondeterministic modeling behavior
- constrains in logic formulas

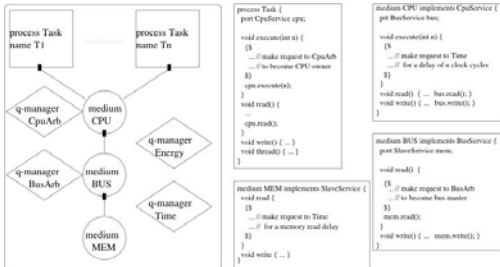
Functional network example



Architecture Modeling

- Offer services to functional model
- Decompose the service into a sequence of events
- Using quantities to annotate and measure costs of events

Architectural network model



1/24/2004

13

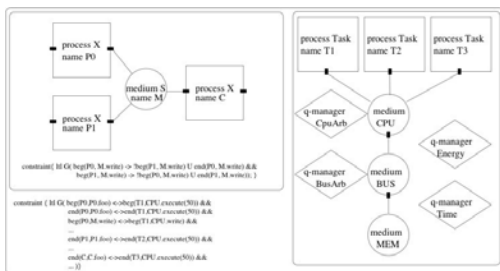
Mapping

- Relating functional and architectural networks by synchronizing events
- Eliminate the nondeterministic executions
- execute the concurrent processes

1/24/2004

14

Mapping network



1/24/2004

15

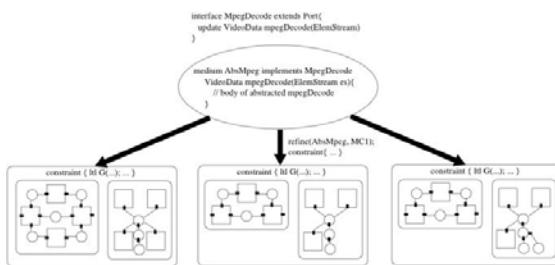
Recursive paradigm of platforms

- Consider the mapping network itself as an implementation of a certain service
- Many mapping networks can exist for the same service
- Enable design reuse
- Example: BUS model and MPEG decoder

1/24/2004

16

Recursive paradigm of platforms



1/24/2004

17

TOOLS

- Metropolis includes tools for:
 - Formal property verification
 - Spin
 - Simulation monitors
 - Logic of constraints (LOC)
 - Synthesis: Quasi-static scheduling
 - schedule concurrent specification on computational resources with limited concurrency

1/24/2004

18

Conclusion

- Metropolis's rigorous design framework:
 - Metamodel's formal semantics
 - Design reuse and design chain support
- Facilitate the dialog among designers from different domain
- Easy to plug in other tools as its solvers

Thank you