

A POLYNOMIAL TIME FLOW FOR IMPLEMENTING FREE CHOICE PETRI-NETS

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OVERVIEW

Aim of this Work

Petrinet Operation

Existing Petri-Net Implementation Flows

Proposed Flow

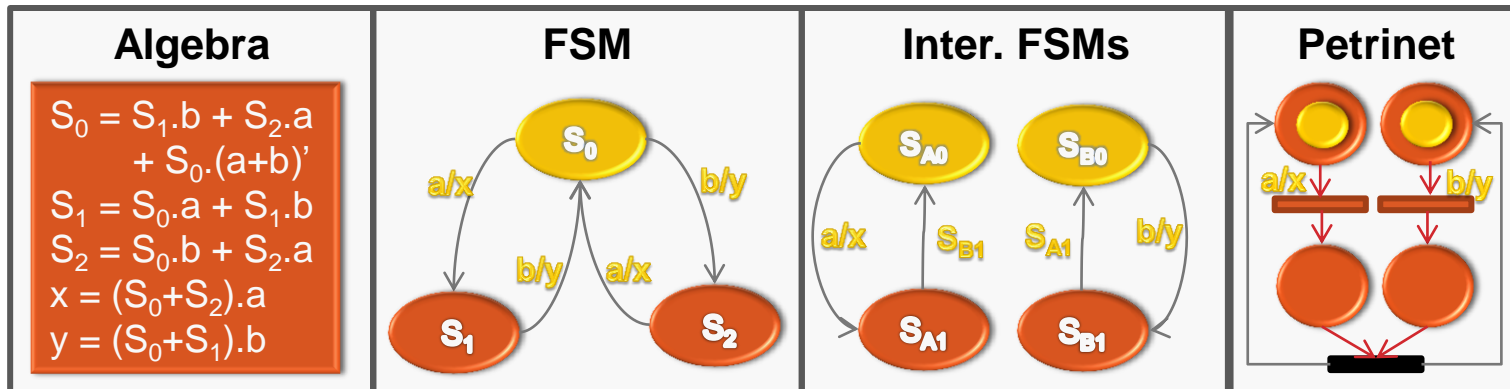
Results

Future Work



WHY PETRINETTS?

Concurrent input events a and b cause output events x and y respectively. Neither of a and b are allowed to fire unless x and y have both fired.



Control Model	State	Choice	Concurrency	Synchronization
<i>Algebra</i>	Implicit	Implicit	Implicit	Implicit
<i>FSM</i>	Explicit	Explicit	Implicit	Implicit
<i>Inter. FSMs</i>	Explicit	Explicit	Explicit	Implicit
<i>Petrinet</i>	Explicit	Explicit	Explicit	Explicit



STATE OF THE ART CONTROL SYNTHESIS

Interacting FSM Synthesis

- FSM Composition and Decomposition (VIS)
- Input Don't Cares and Permissible Behaviors(S1S)

FSM Synthesis

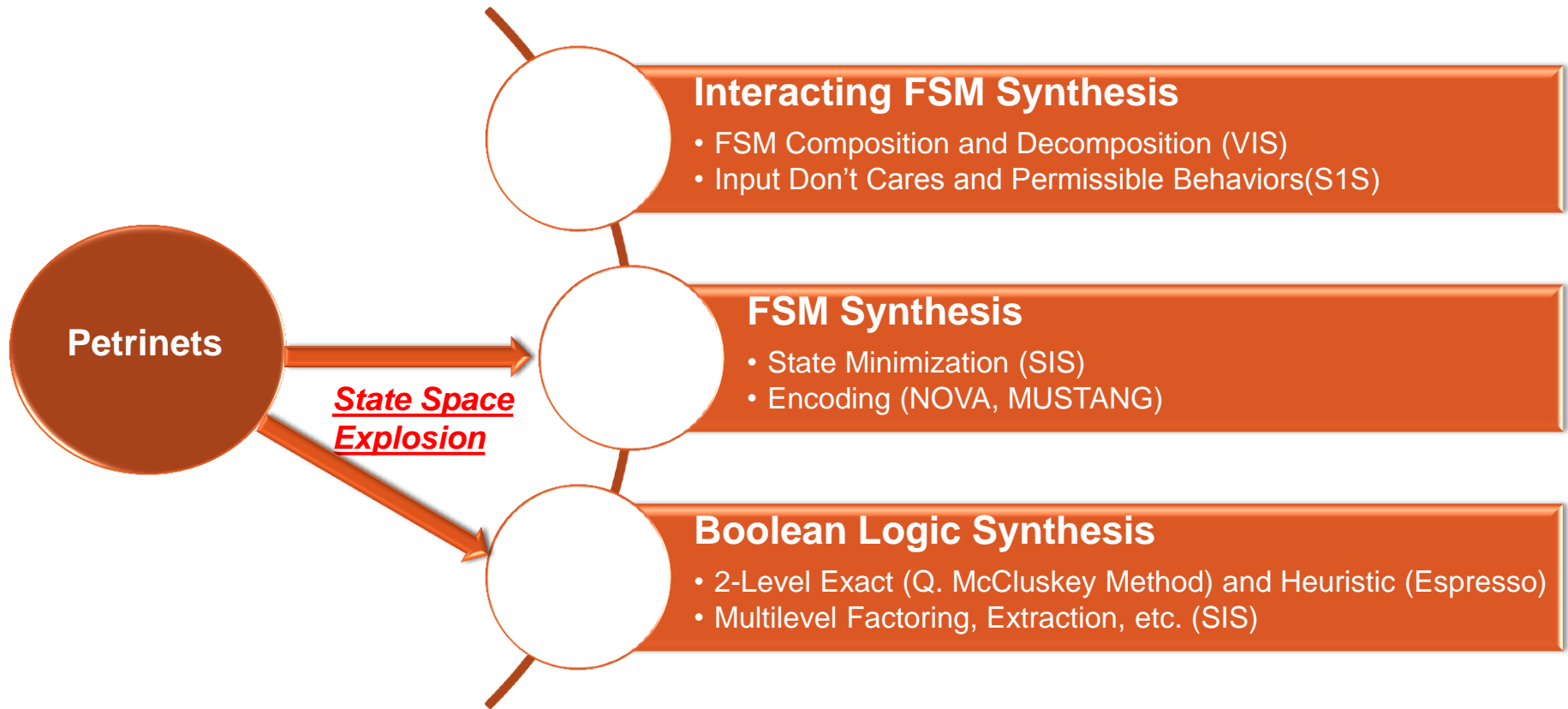
- State Minimization (SIS)
- Encoding (NOVA, MUSTANG)

Boolean Logic Synthesis

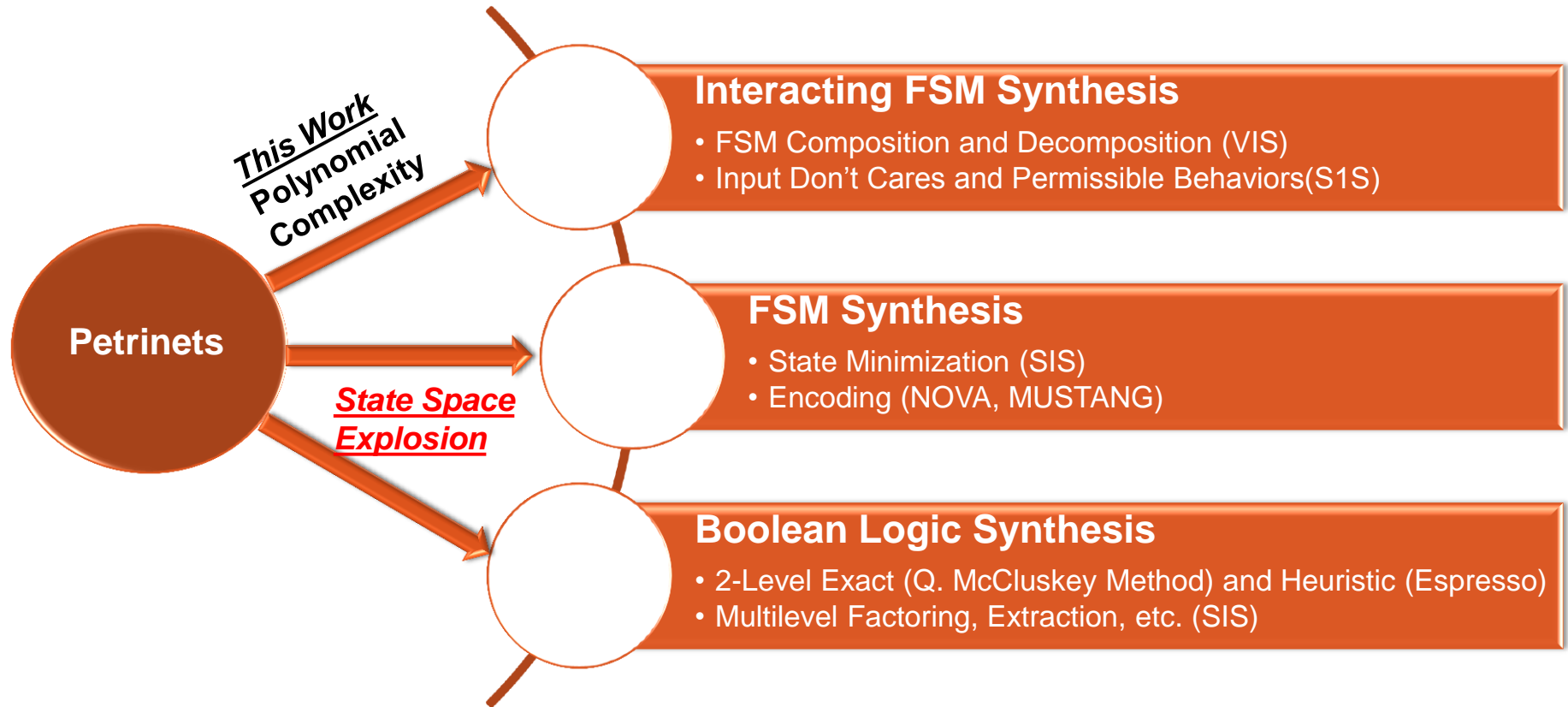
- 2-Level Exact (Q. McCluskey Method) and Heuristic (Espresso)
- Multilevel Factoring, Extraction, etc. (SIS)



STATE OF THE ART CONTROL SYNTHESIS



AIM OF THIS WORK



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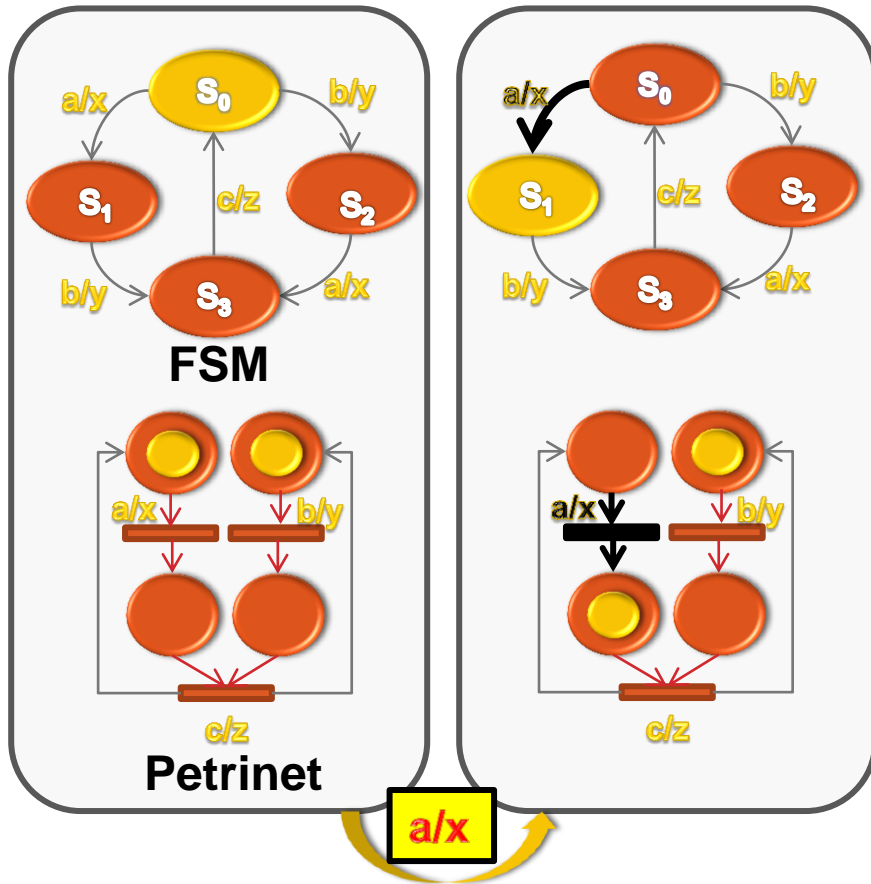
Proposed Flow

Results

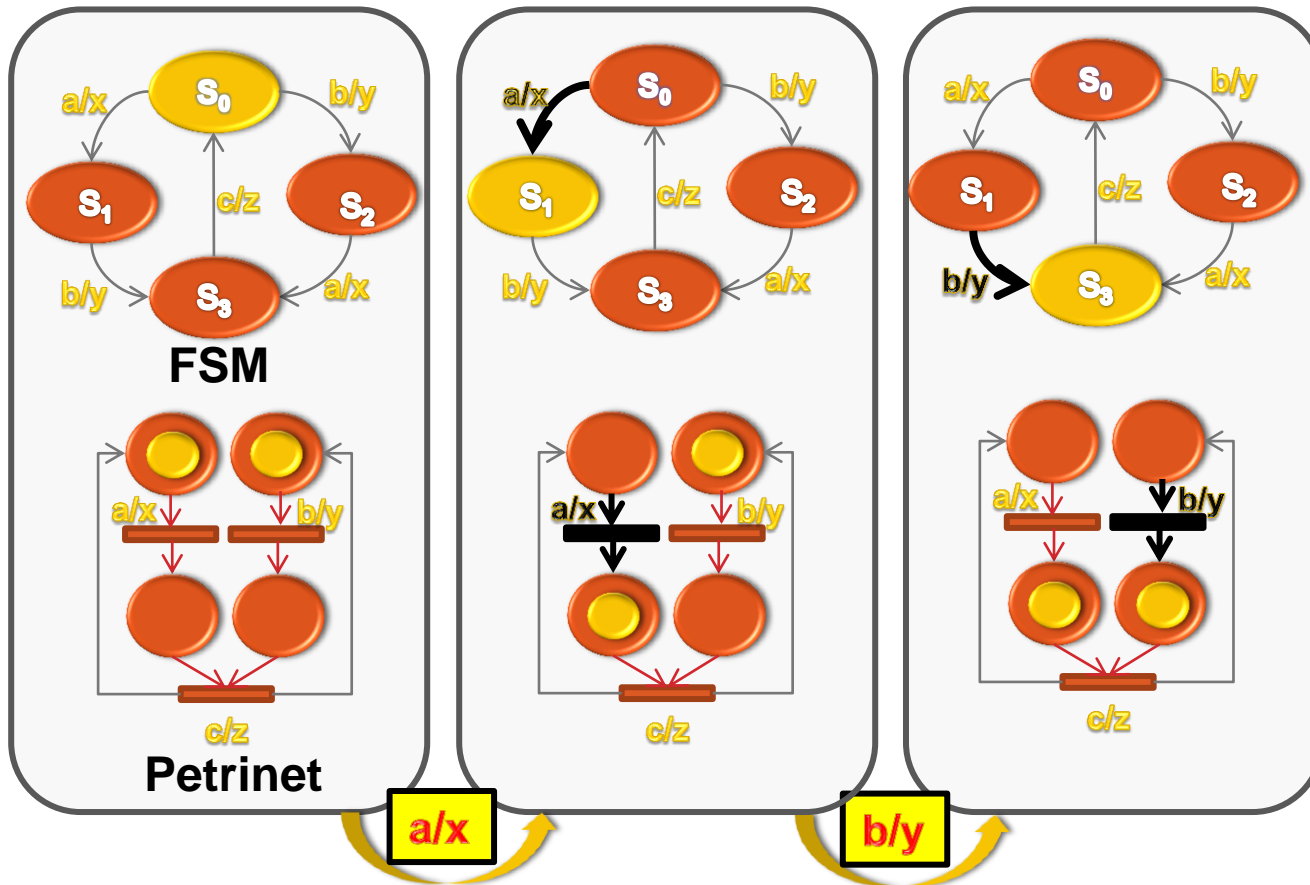
Future Work



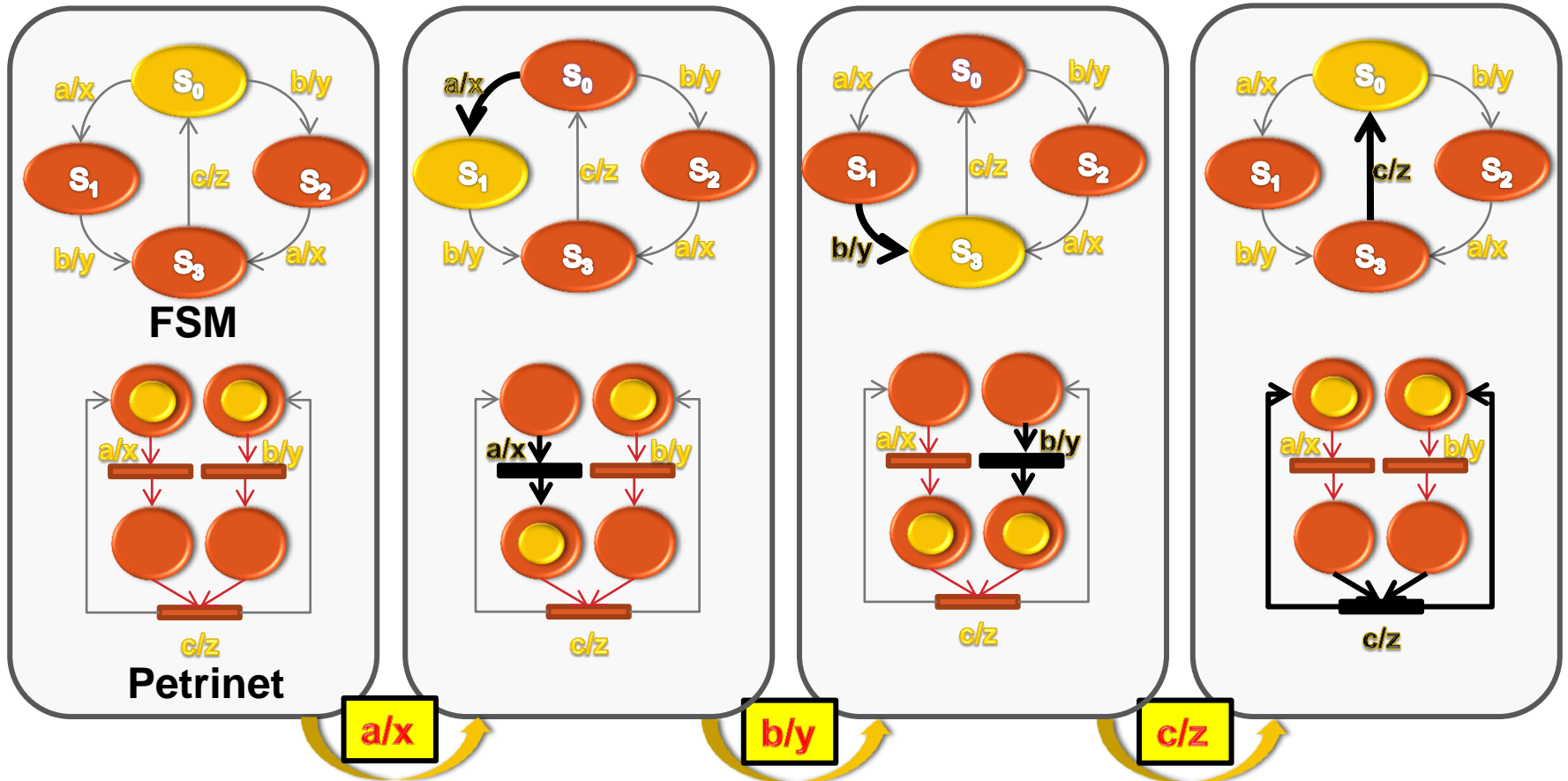
PETRINET OPERATION



PETRINET OPERATION



PETRINET OPERATION



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POPULAR PETRI-NET IMPLEMENTATION FLOWS

Direct Mapping*

- Linear Complexity
- Suboptimal Result

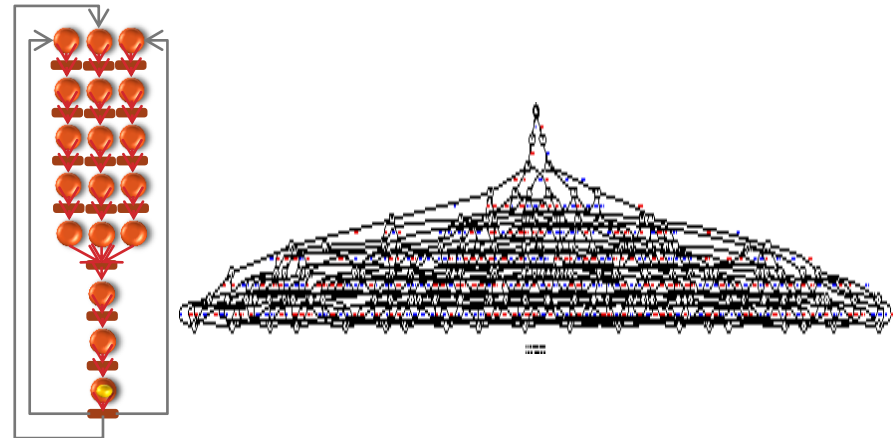


*D. Sokolov, A. V. Bystrov, and A. Yakovlev, "Direct Mapping of Low-Latency Asynchronous Controllers from STGs," IEEE TCAD, 2007.

#J. Cortadella et al., Logic Synthesis of Asynchronous Controllers and Interfaces. Springer-Verlag, 2002.

Synthesis#

- Globally Optimal Result
- Exponential Complexity



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OVERVIEW

Polynomial Petrinet Implementation Flow

Petrinet Decomposition to FSMs

FSMs Synchronization

Petrinet
Decomposition to
S-Components

S-Components
Transformation to
FSMs

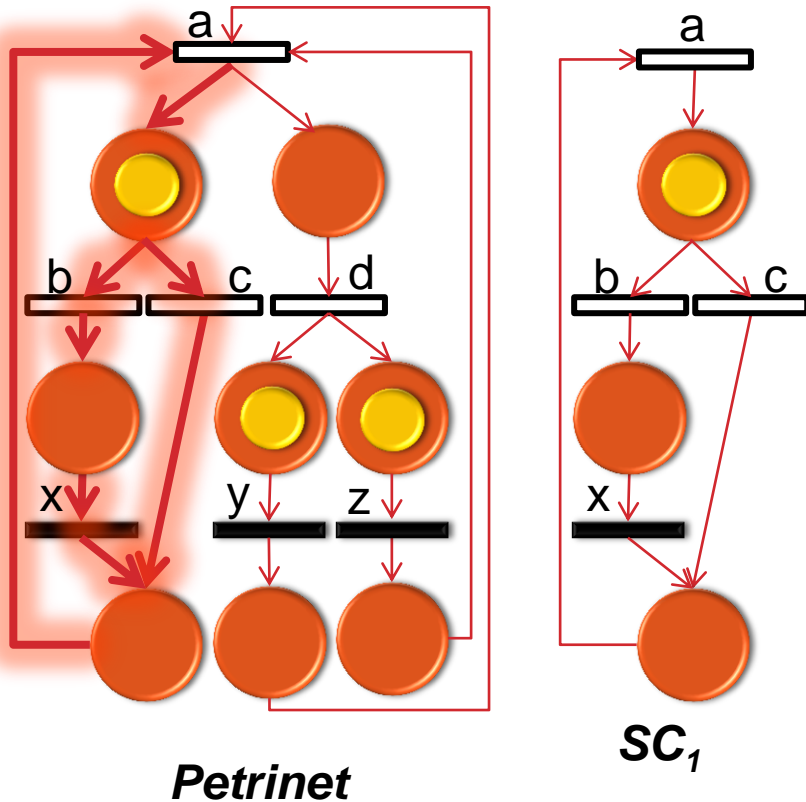
FSMs
Collapsing

Synchronization
Primitives
Extraction

Synchronization
Integration



STEPS (1/5)



Petri net to S-Component Decomposition

S-Component to FSM Mapping

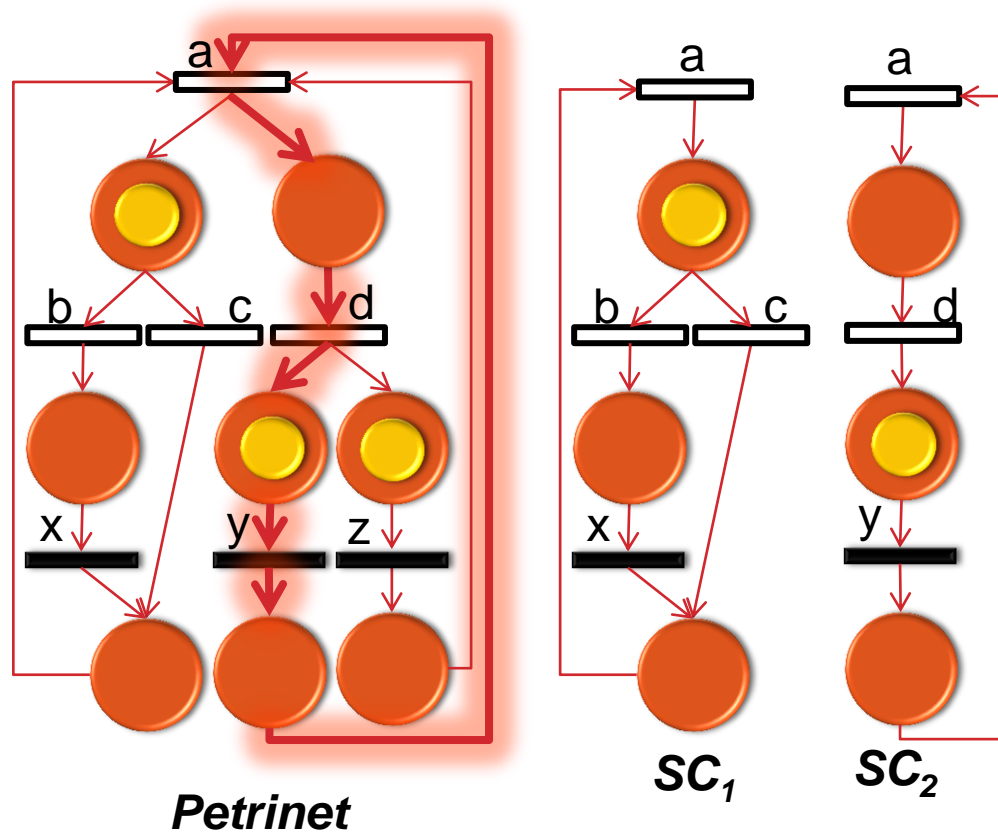
FSMs Collapsing

Synchronization Primitive Extraction

Synchronization Integration



STEPS (1/5)



Petri net to S-Component Decomposition

S-Component to FSM Mapping

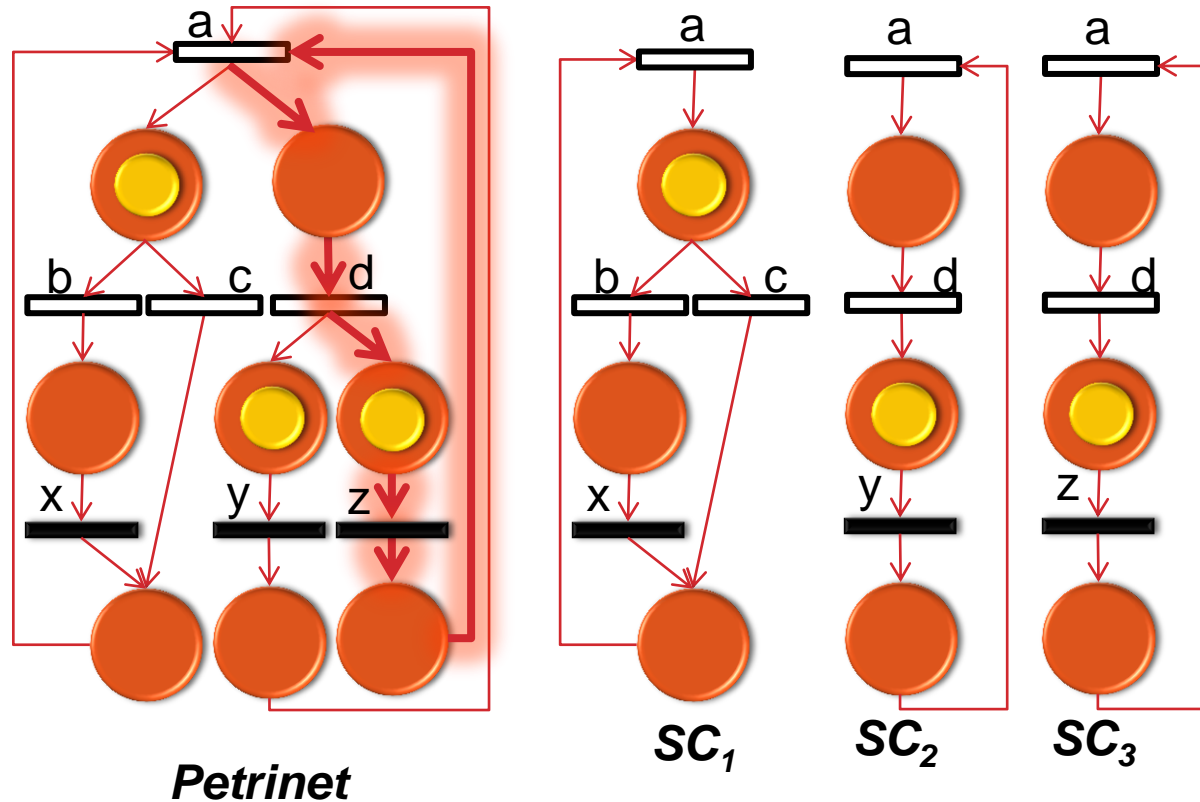
FSMs Collapsing

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Synchronization Integration



STEPS (1/5)



Petri net to S-Component Decomposition

S-Component to FSM Mapping

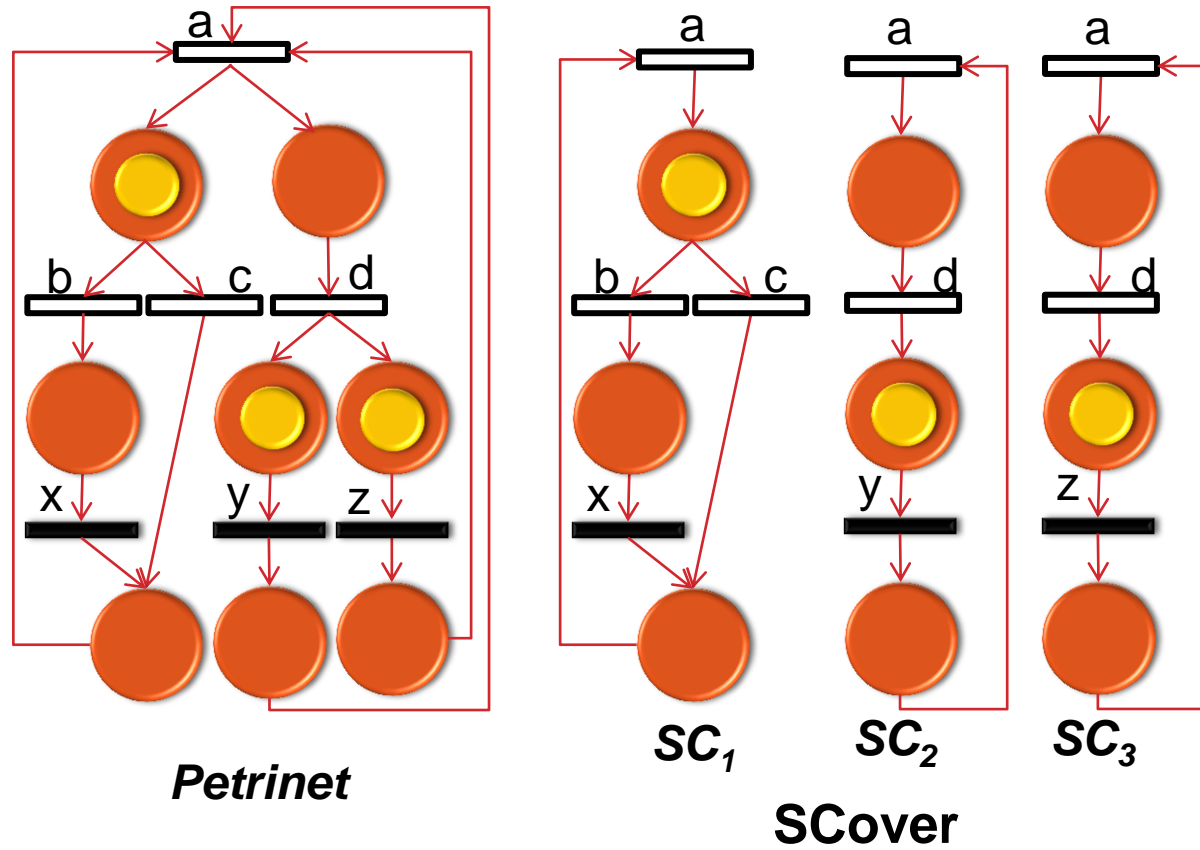
FSMs Collapsing

Synchronization Primitive Extraction

Synchronization Integration



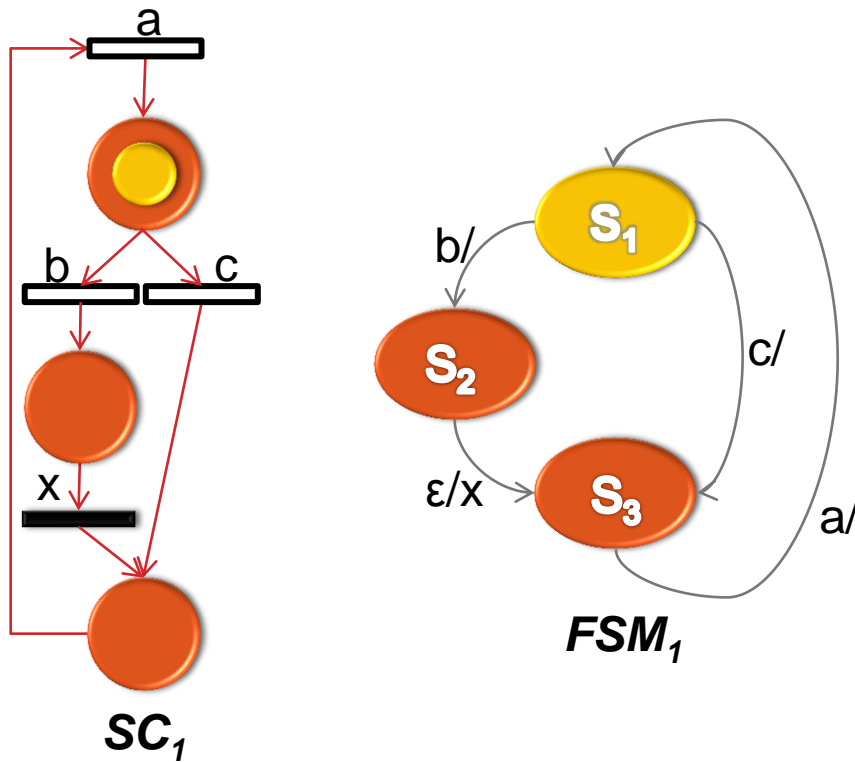
STEPS (1/5)



- Petri net to S-Component Decomposition
- S-Component to FSM Mapping
- FSMs Collapsing
- Synchronization Primitive Extraction
- Synchronization Integration



STEPS (2/5)



Petri net to S-Component Decomposition

S-Component to FSM Mapping

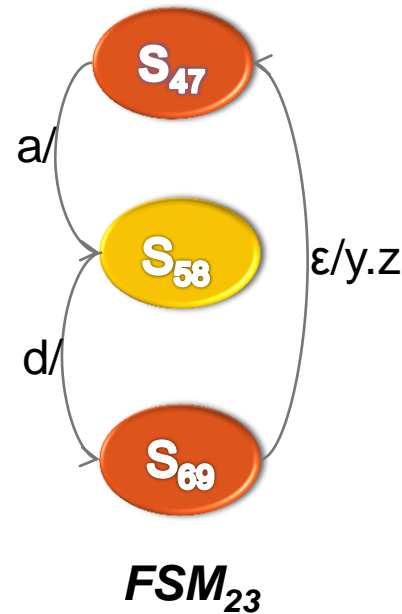
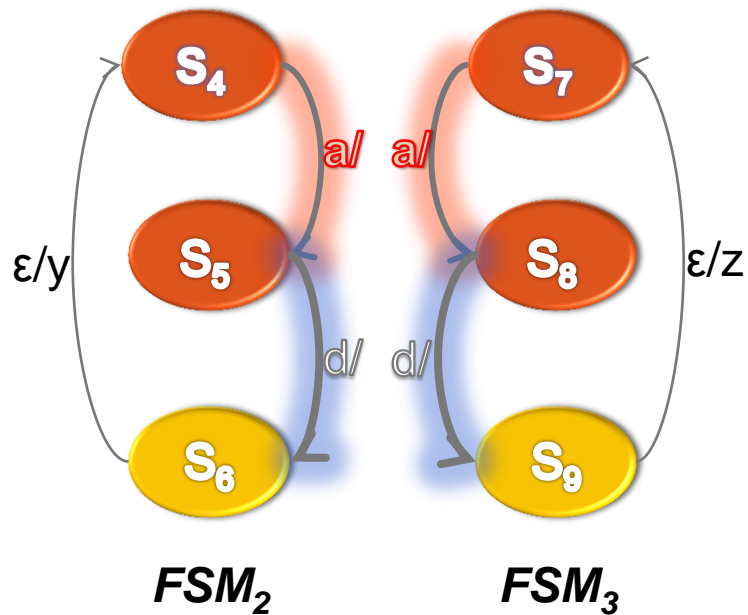
FSMs Collapsing

Synchronization Primitive Extraction

Synchronization Integration



STEPS (3/5)



Petrinet to S-Component Decomposition

S-Component to FSM Mapping

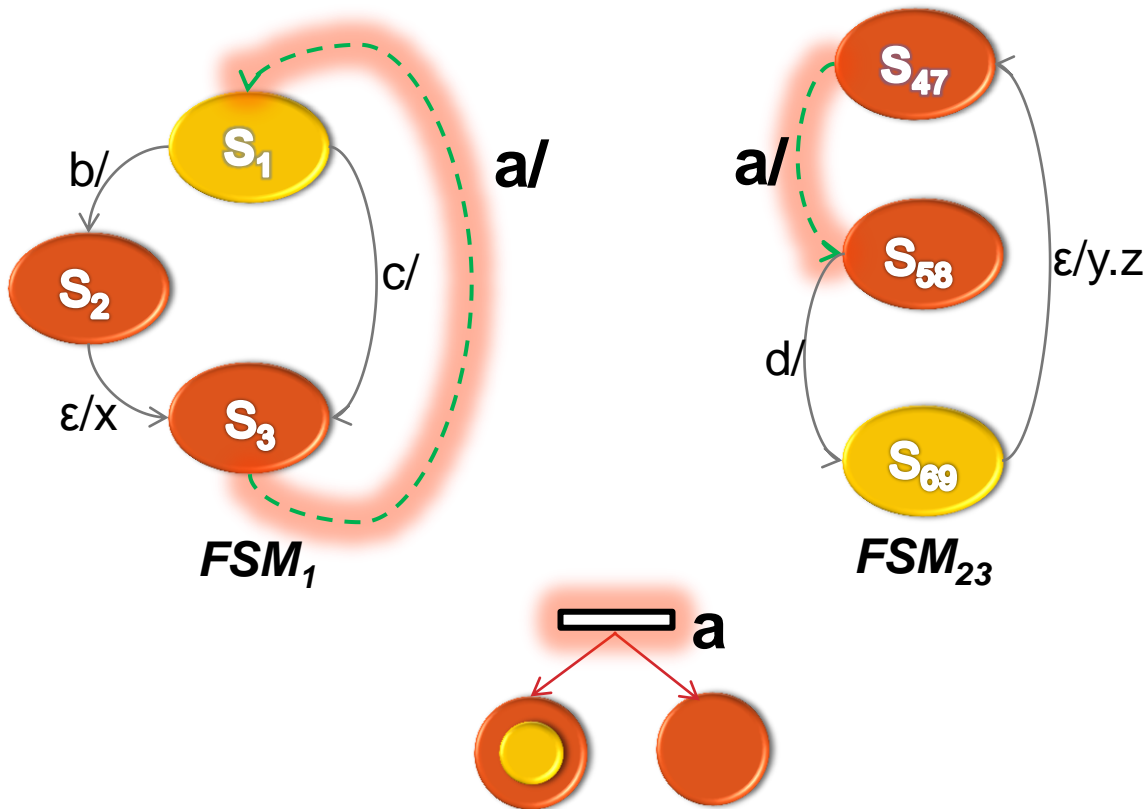
FSMs Collapsing

Synchronization Primitive Extraction

Synchronization Integration



STEPS (4/5)



Petri net to S-Component Decomposition

S-Component to FSM Mapping

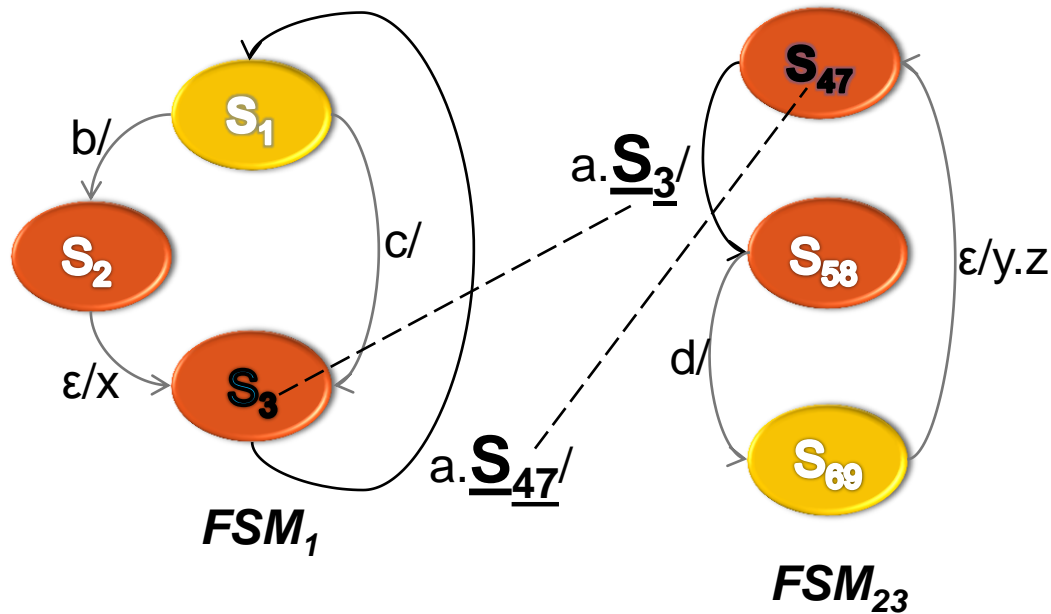
FSMs Collapsing

Synchronization Primitive Extraction

Synchronization Integration



STEPS (5/5)



Petrinet to S-
Component
Decomposition

S-Component to
FSM Mapping

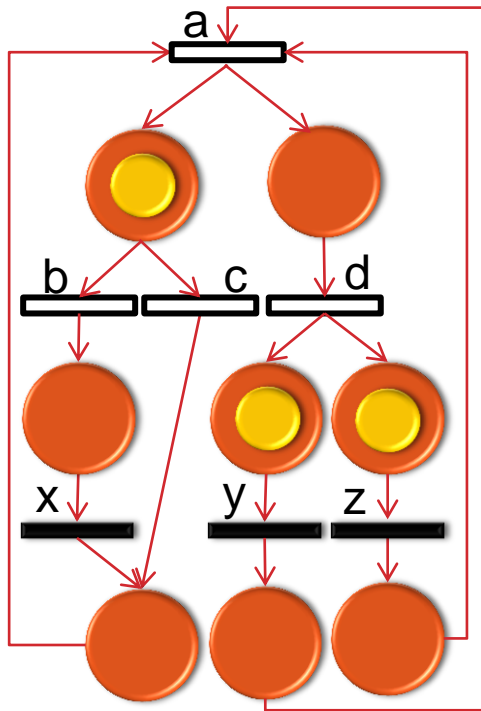
FSMs Collapsing

Synchronization
Primitive
Extraction

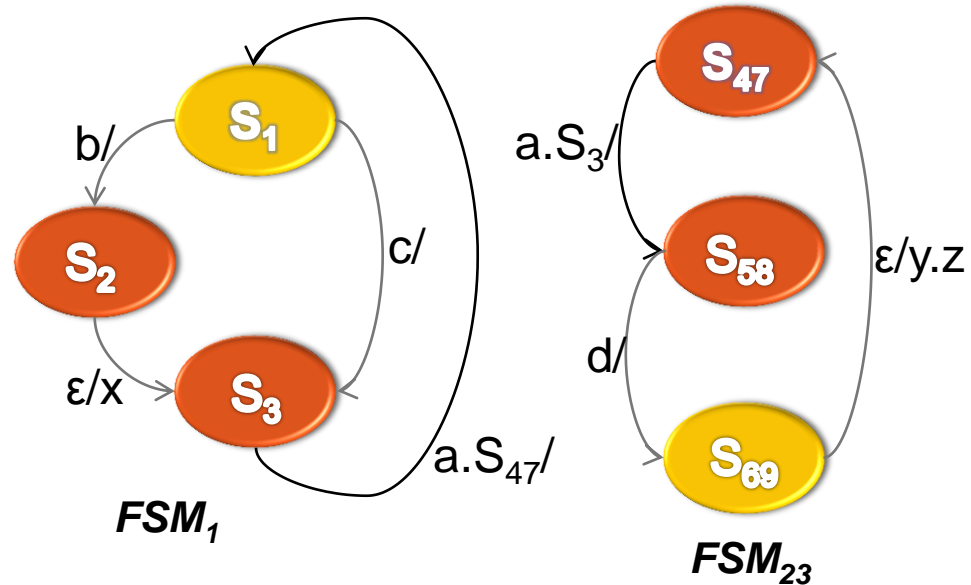
Synchronization
Integration



FINAL RESULT



Petrinet



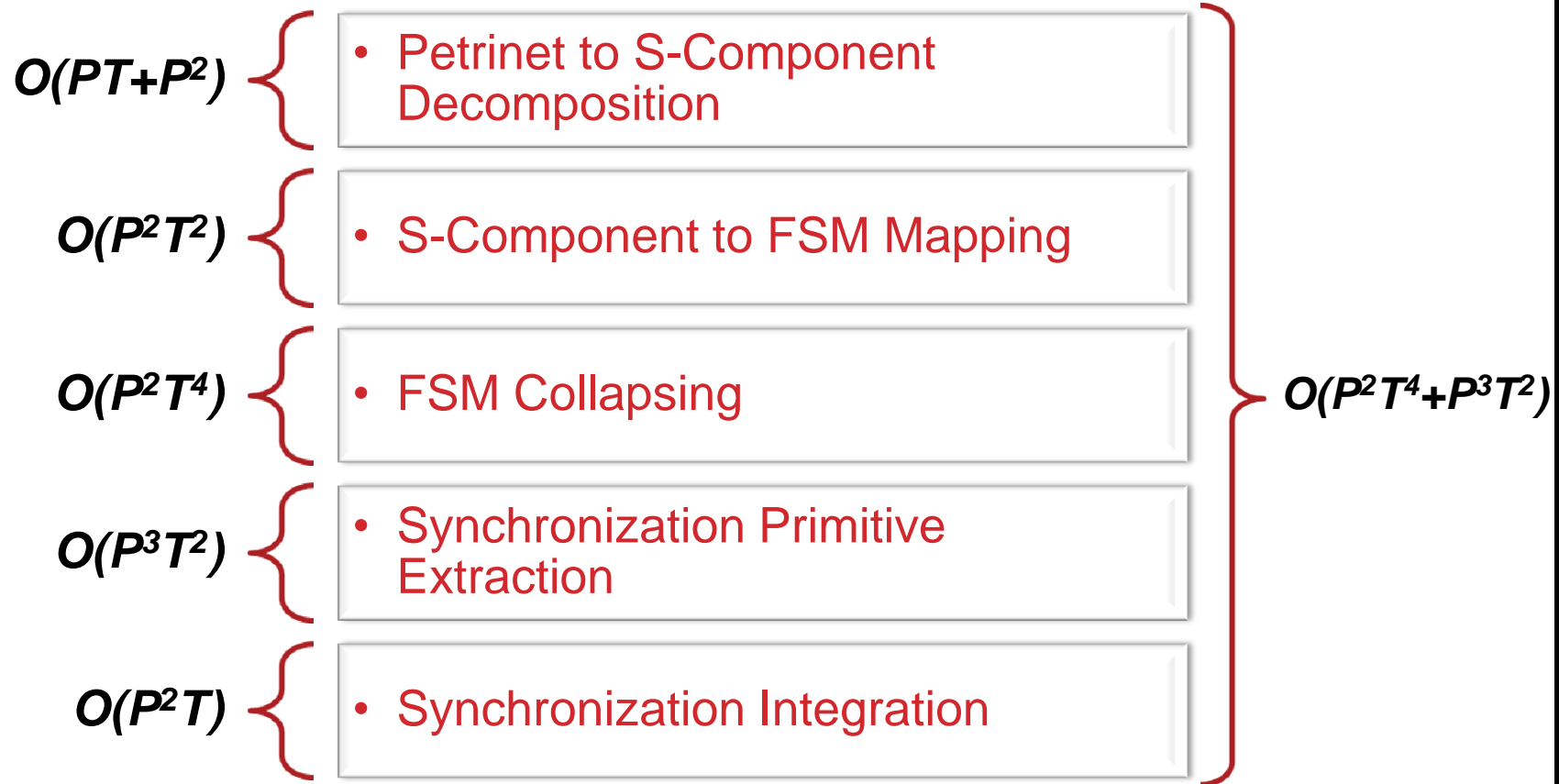
MSFSM

FSMs

Synchronization



COMPLEXITY



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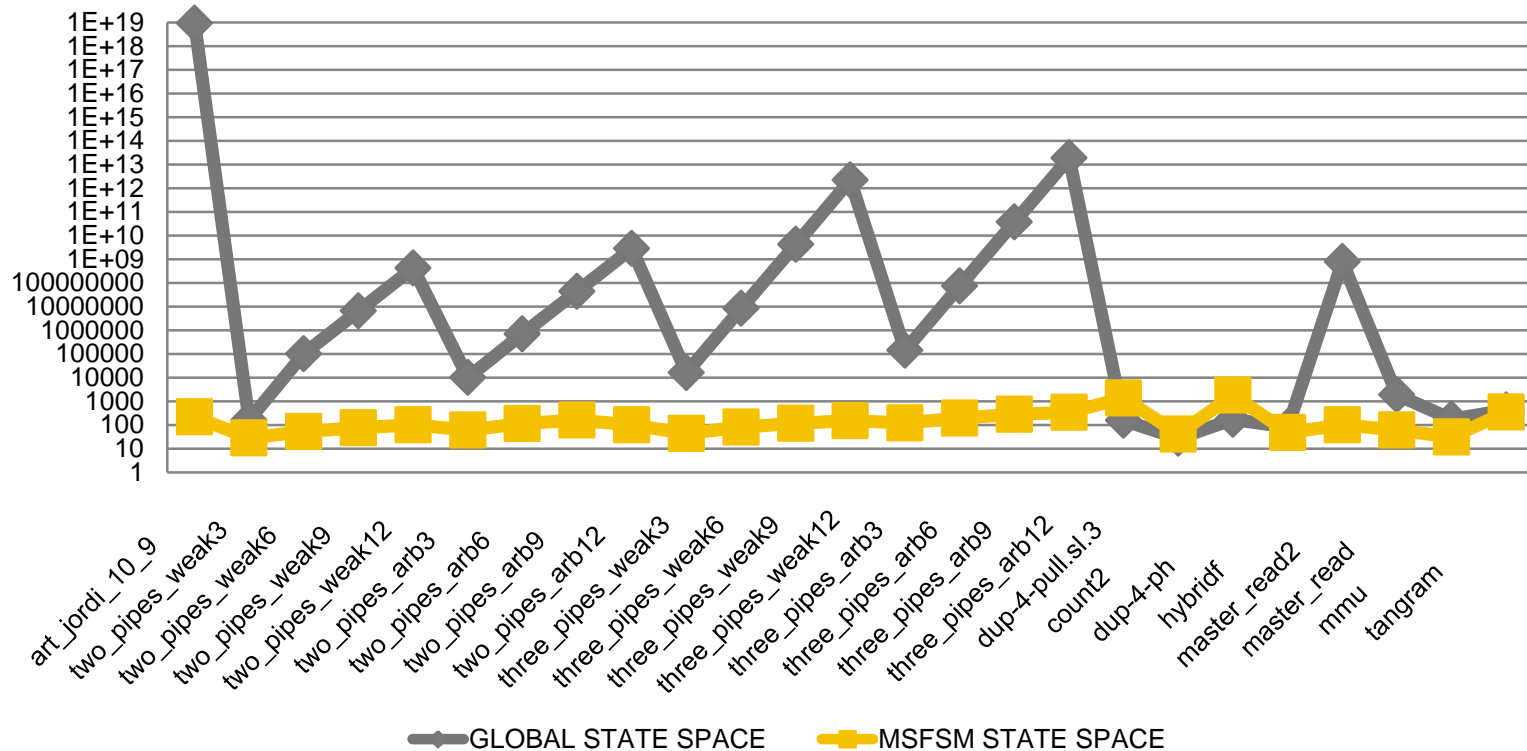
Results

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RESULTS

Global State Space vs. MSFSM State Space



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CONCLUSIONS AND FUTURE WORK

