

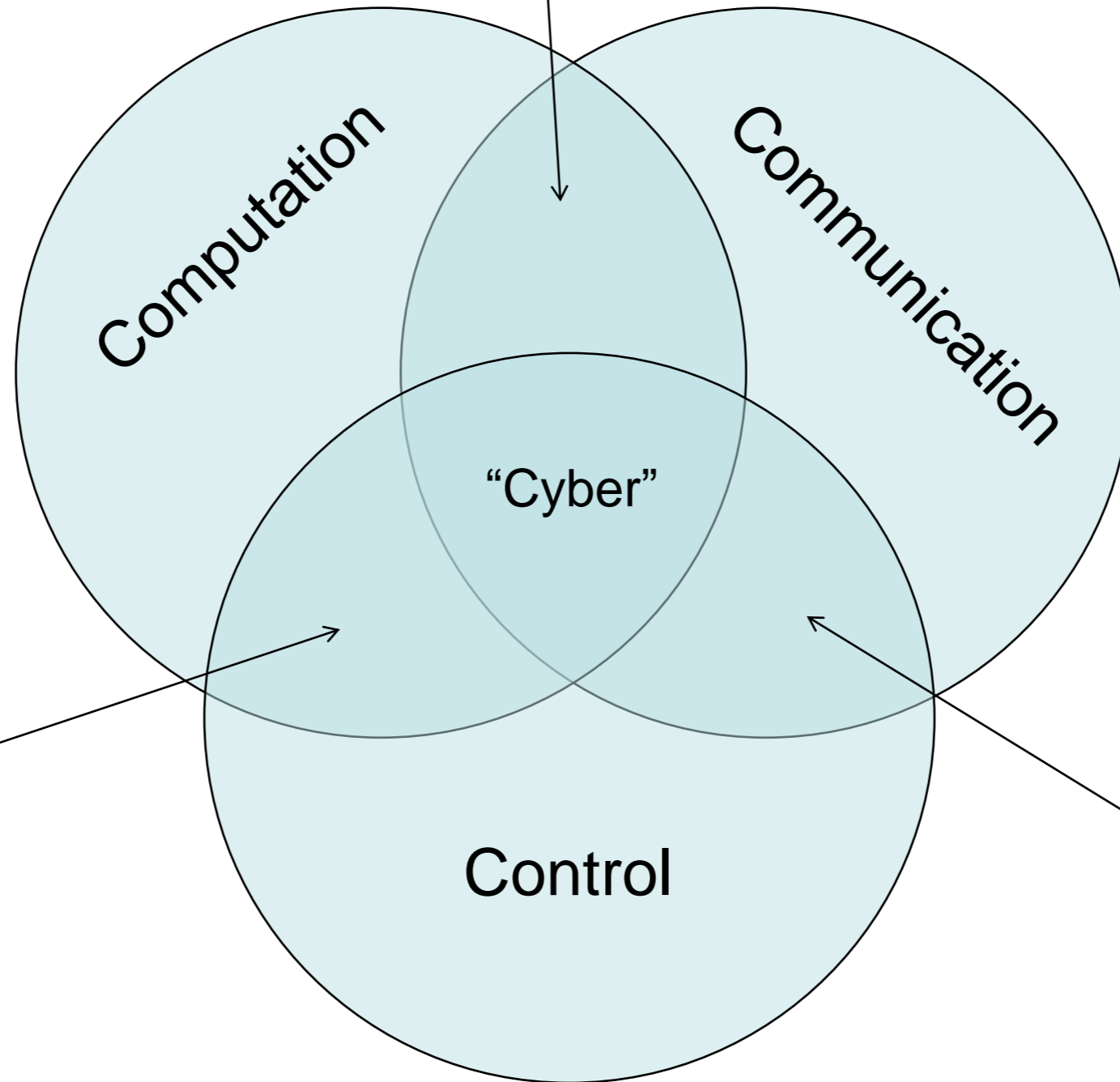
# Generating Model Transformations for Mending Dynamic Constraint Violations in Cyber Physical Systems

Sean Whitsitt and Jonathan Sprinkle





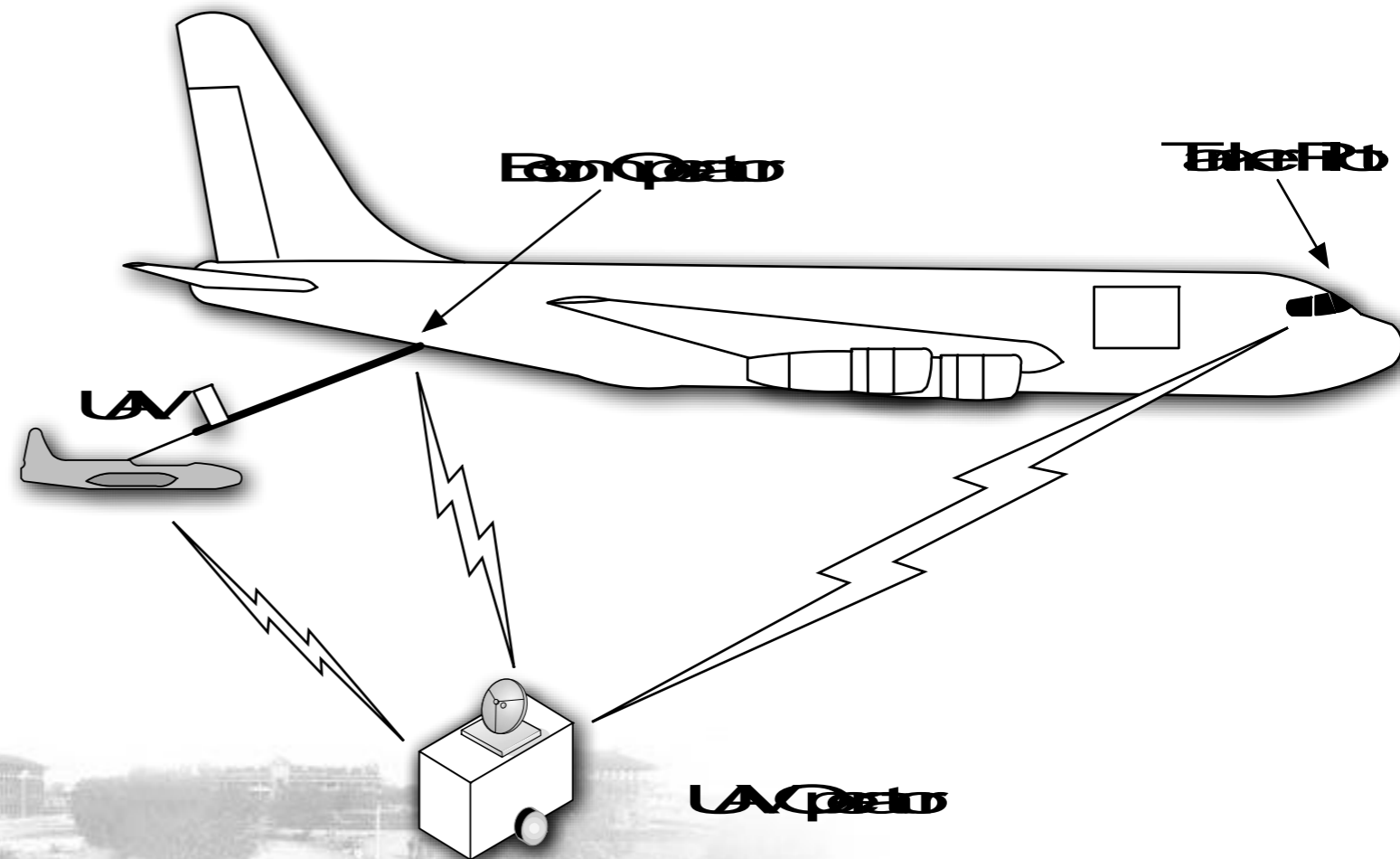
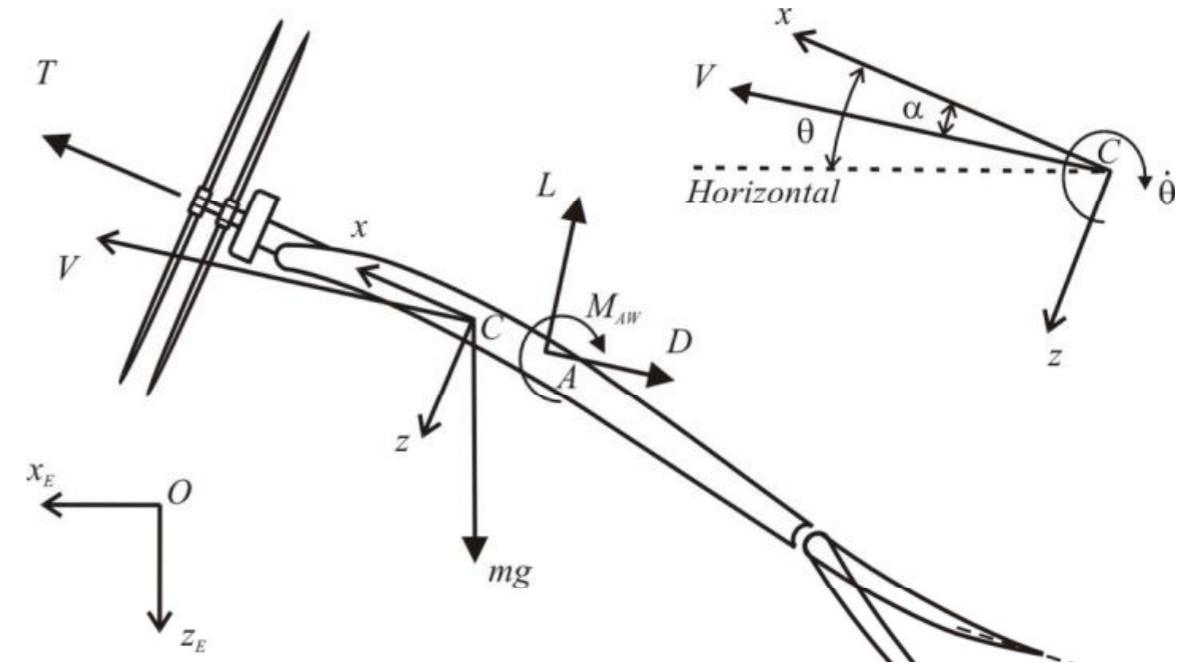
Internet of Things  
Sensor Networks



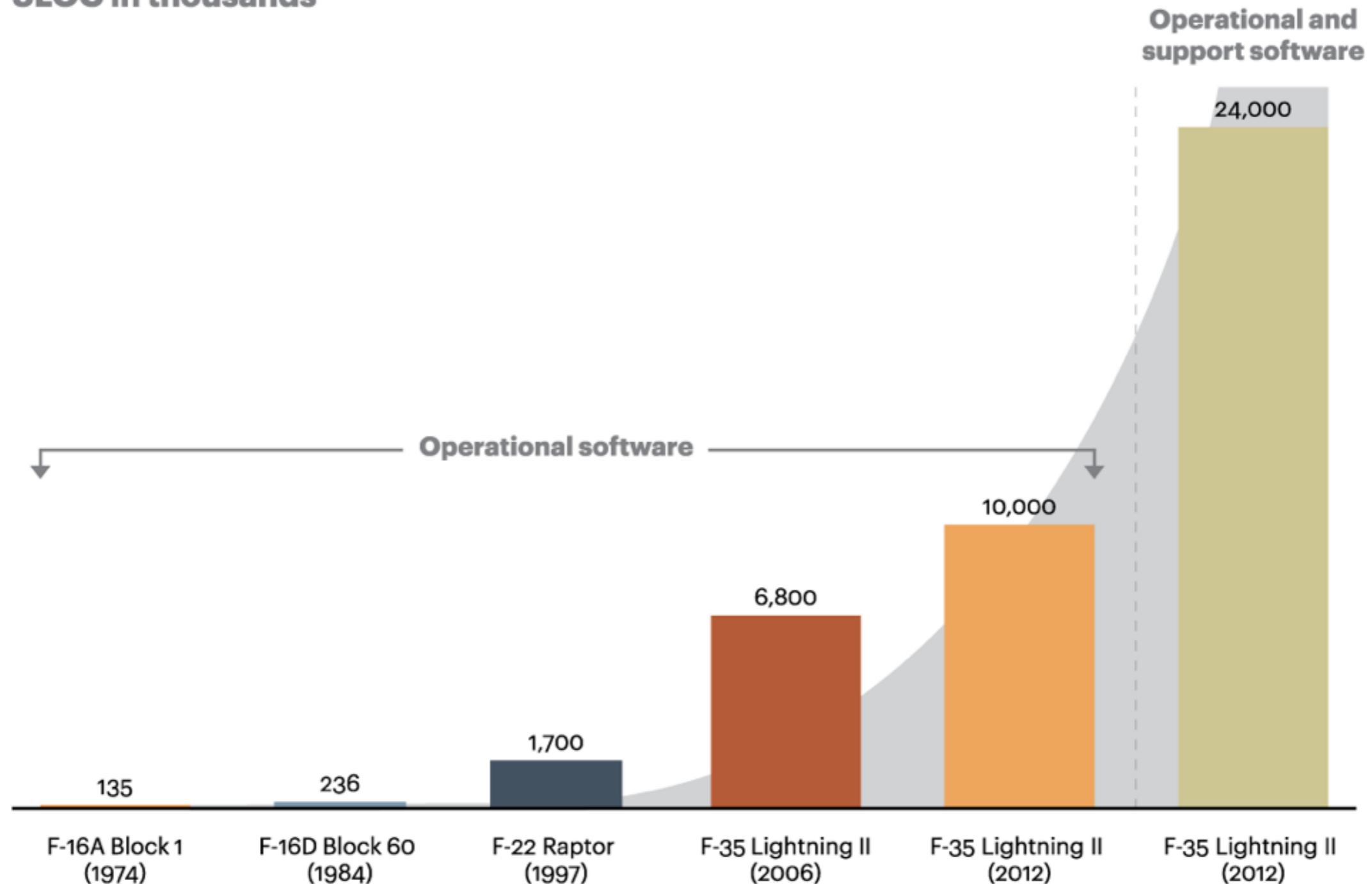
Embedded Control  
Real-Time Control  
Discrete Control

Distributed Control  
SCADA

- 1) Governed by laws of physics
- 2) In continuous time.

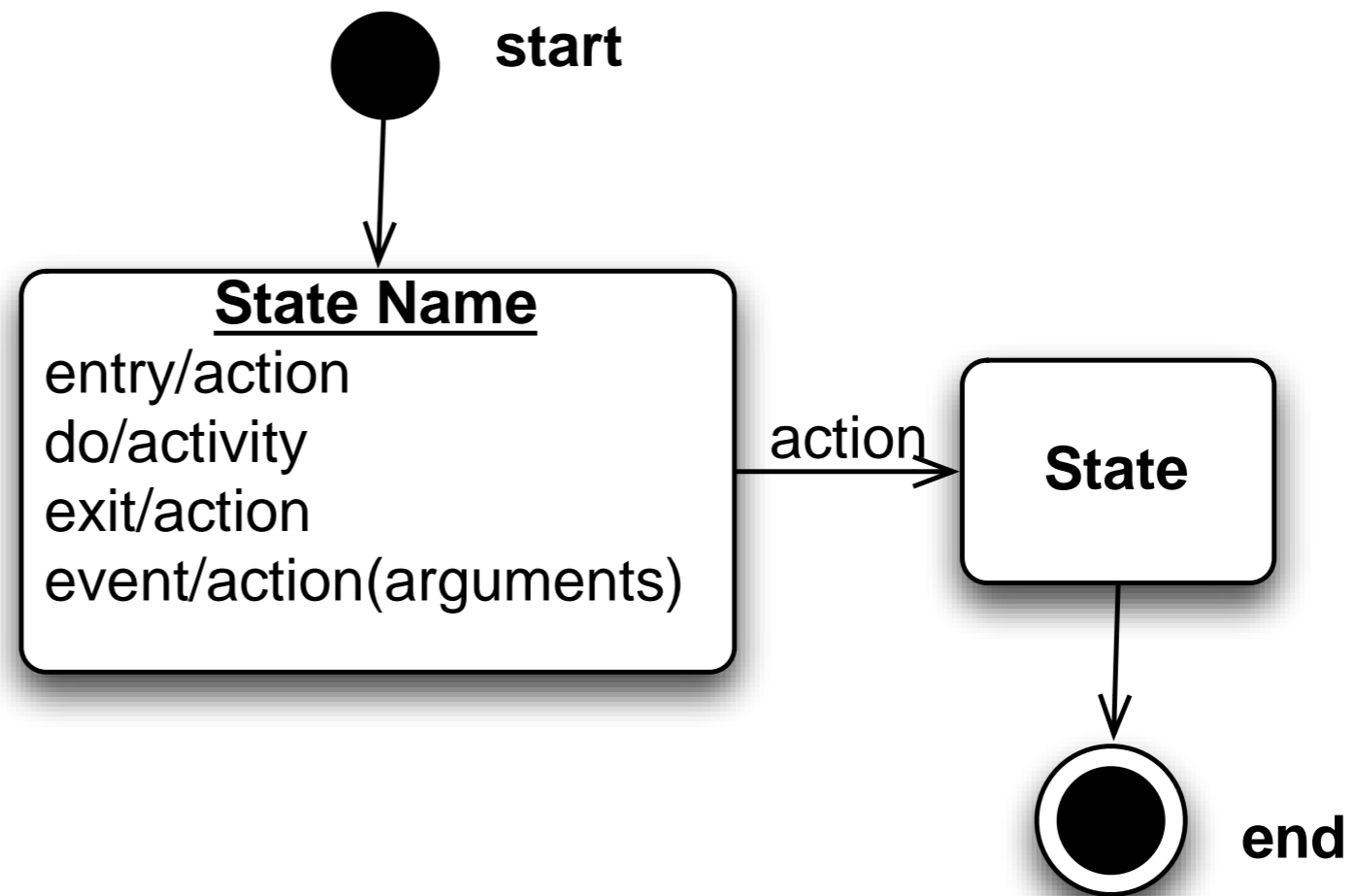
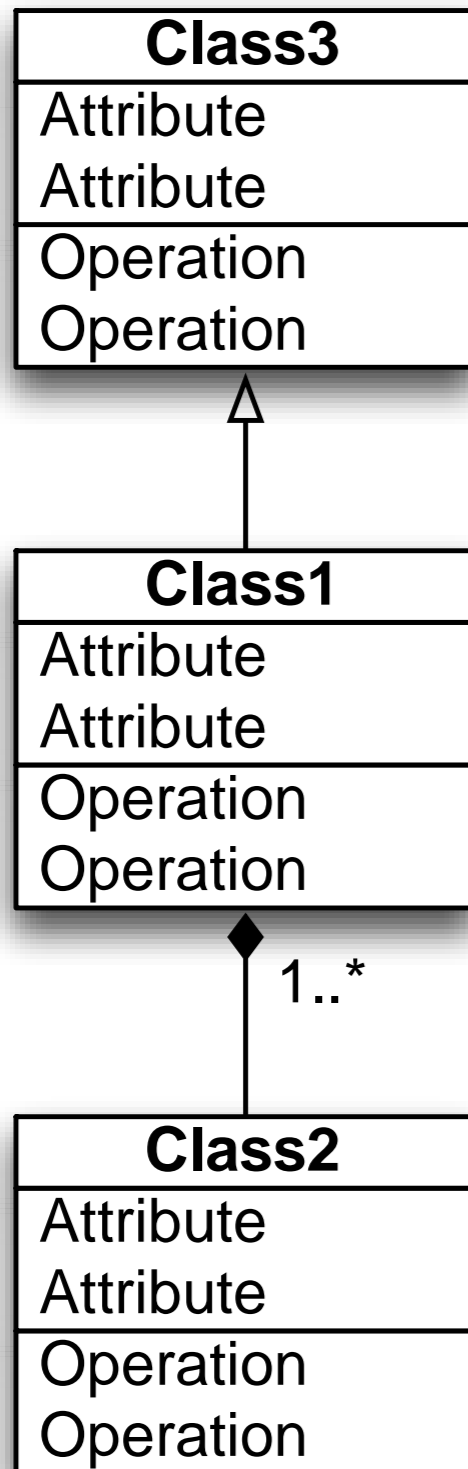


## SLOC in thousands



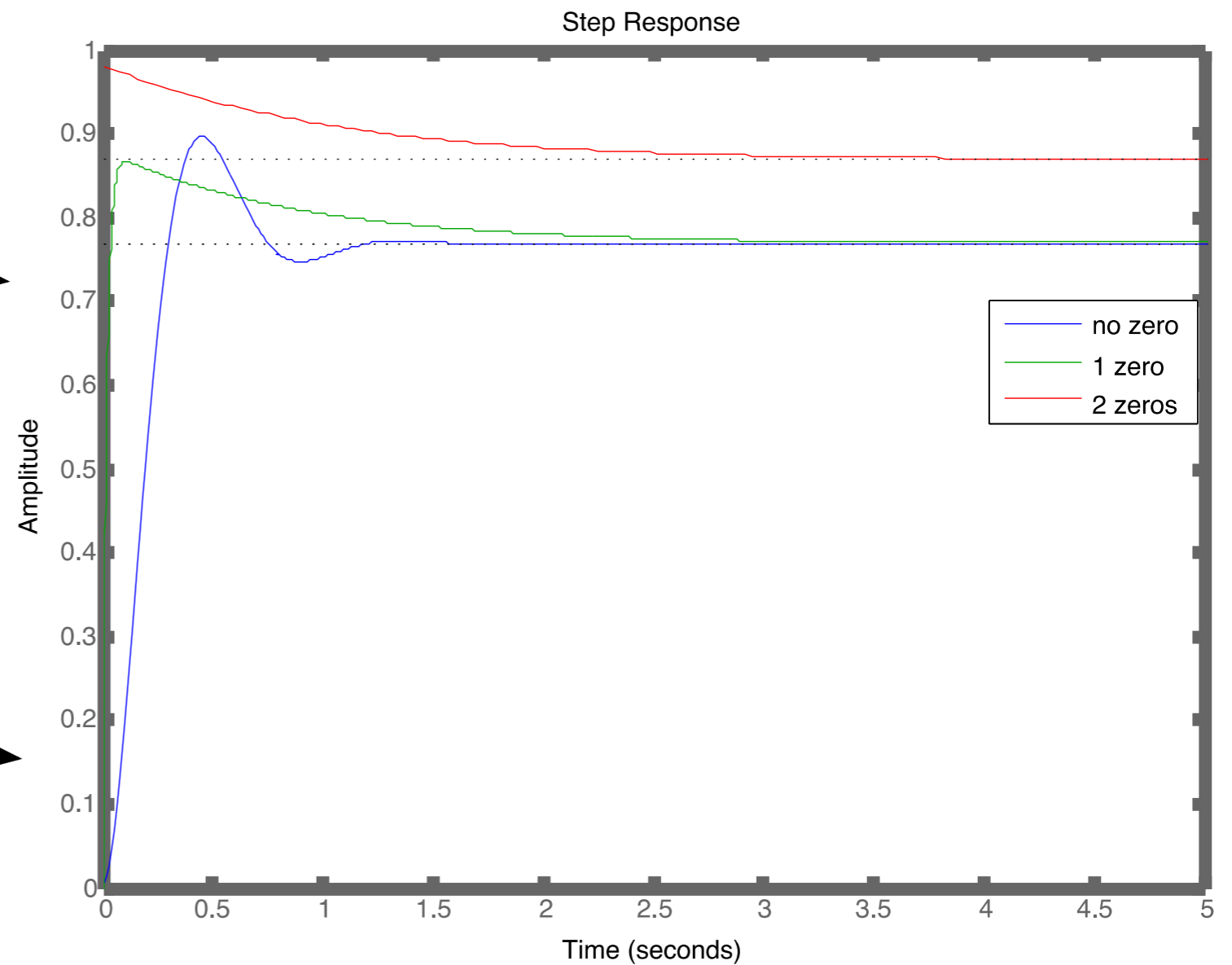
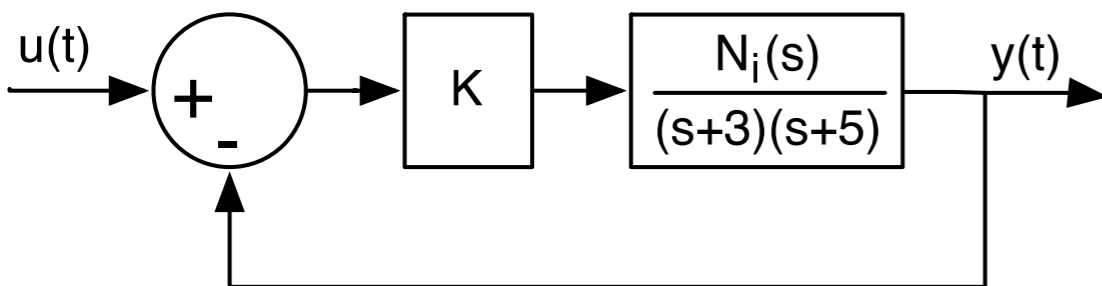
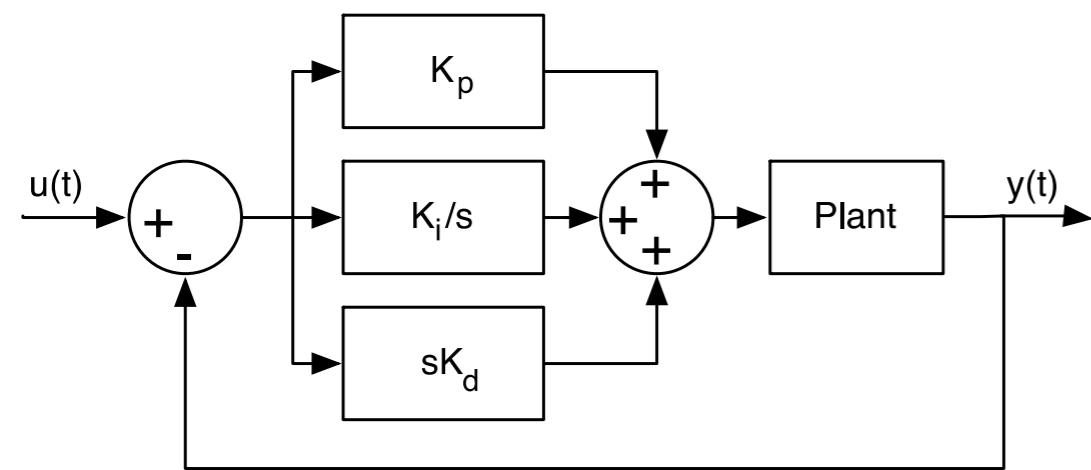
Notes: SLOC for F-16 and F-22 are at first operational flight. F-35 SLOC figures are from first test flight and current estimates/sources.

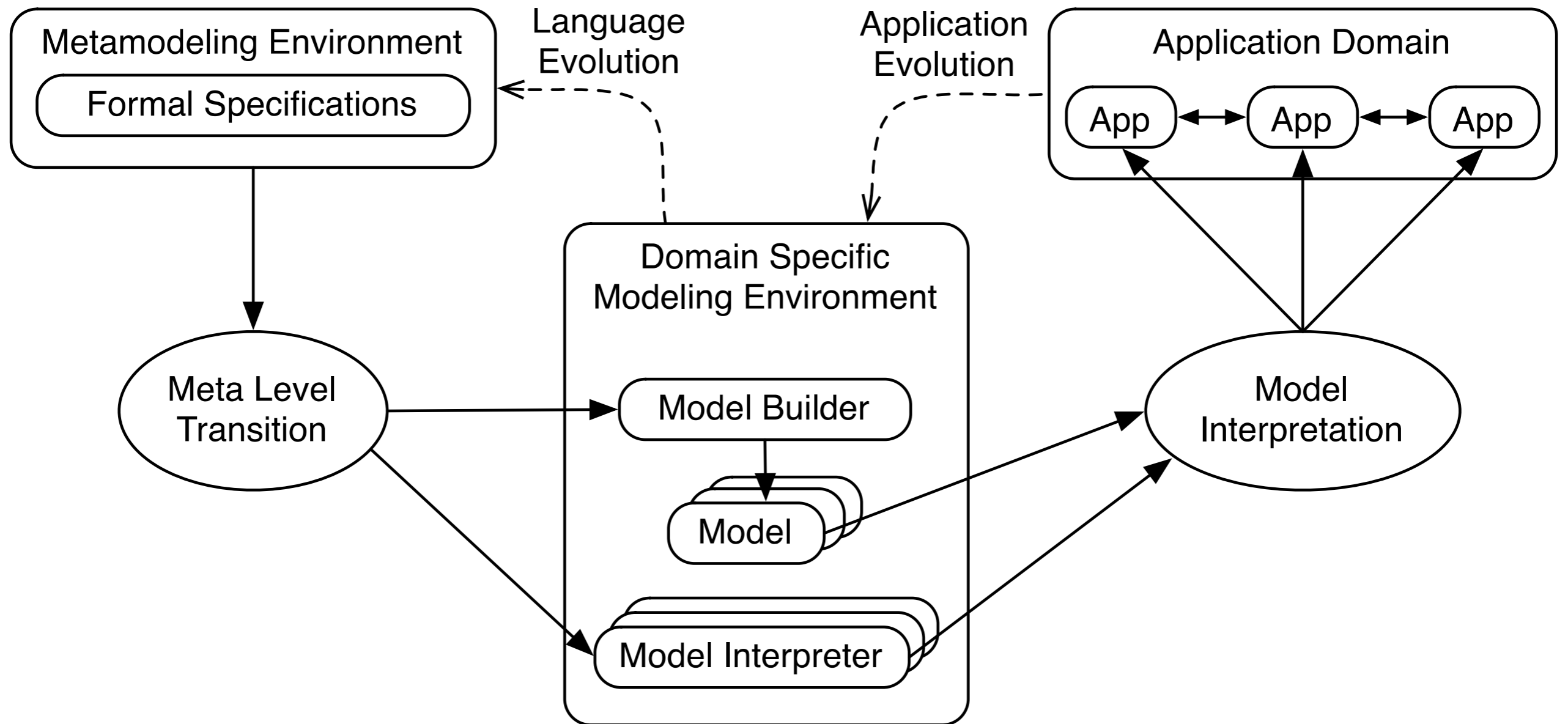
Sources: P. Judas and L.E. Prokop, "A historical compilation of software metrics with applicability to NASA's Orion spacecraft flight software sizing," *Innovations in Systems and Software Engineering*, vol. 7 issue 3, September 2011. p. 161-170; Andrea Shalal-Esa, "Pentagon focused on resolving F-35 software issues," *Reuters*, March 2012; Robert N. Charette, "F-35 Program Continues to Struggle with Software," *IEEE Spectrum*, September 2012

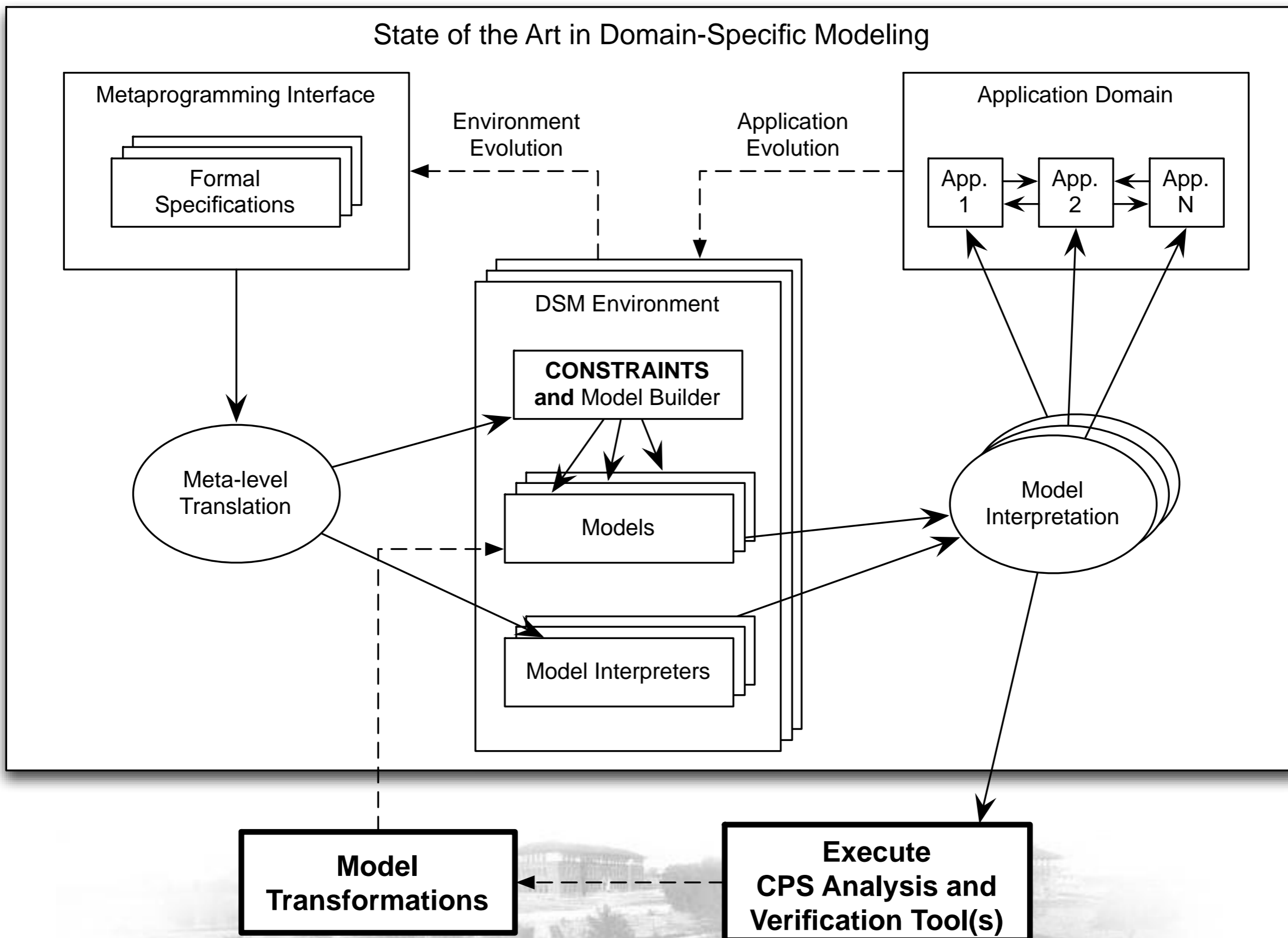




Any constraint that requires some analysis on system artifacts or models.

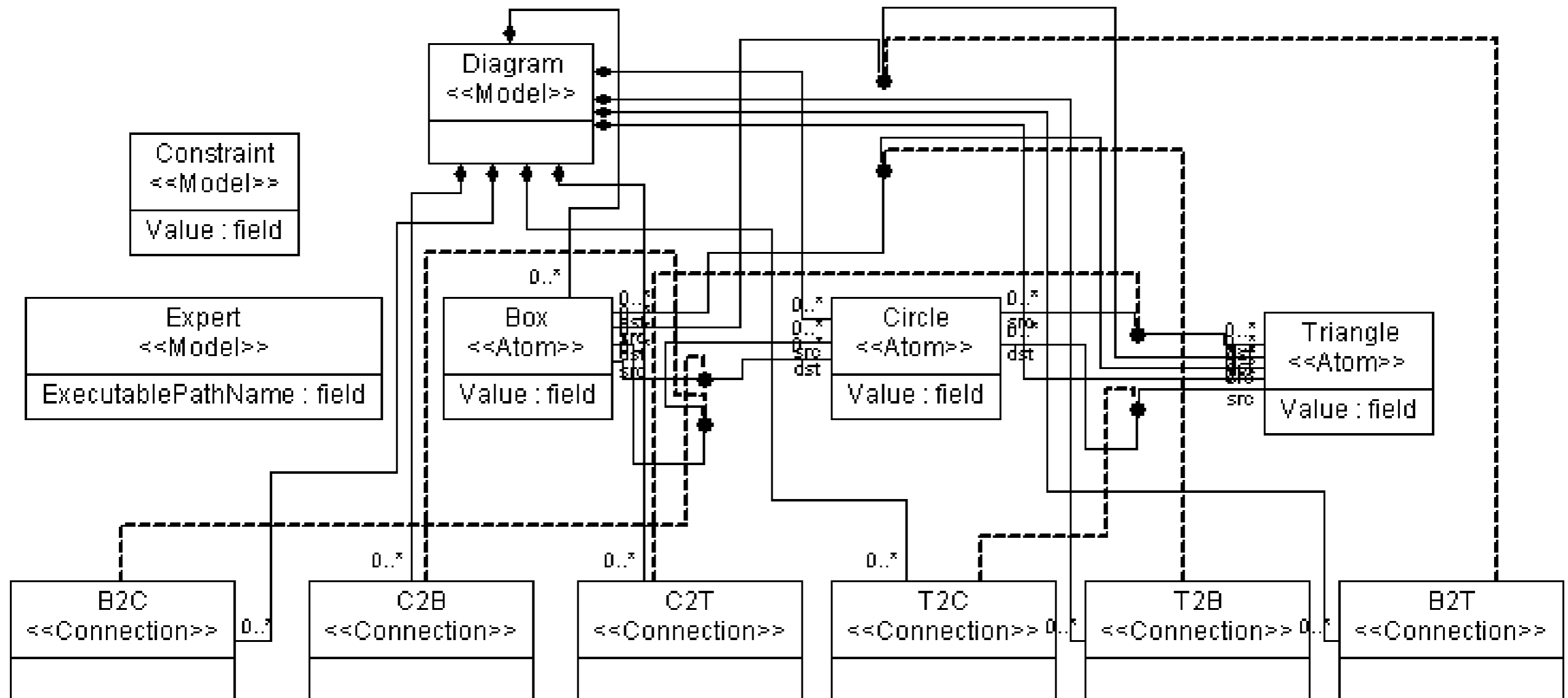


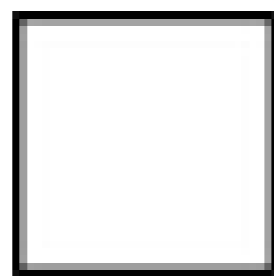




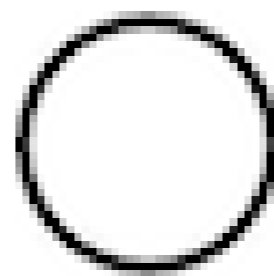


# SimpleSim Metamodel

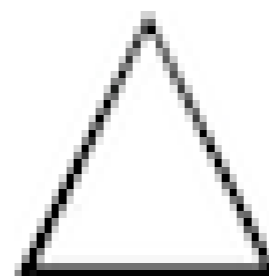




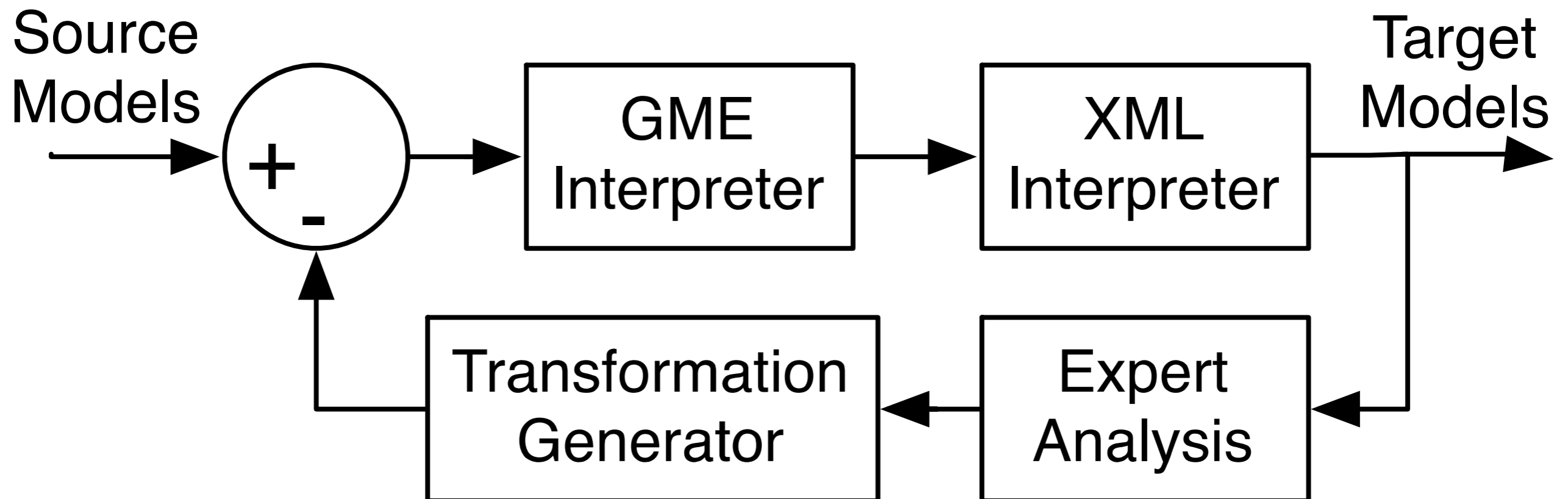
Box



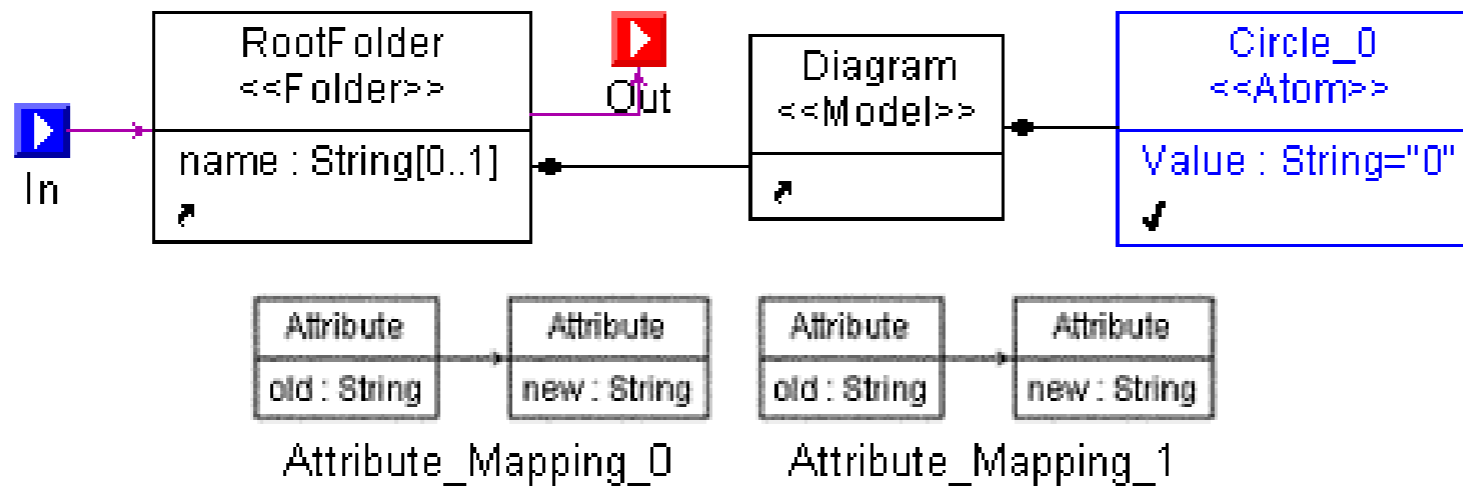
Circle



Triangle

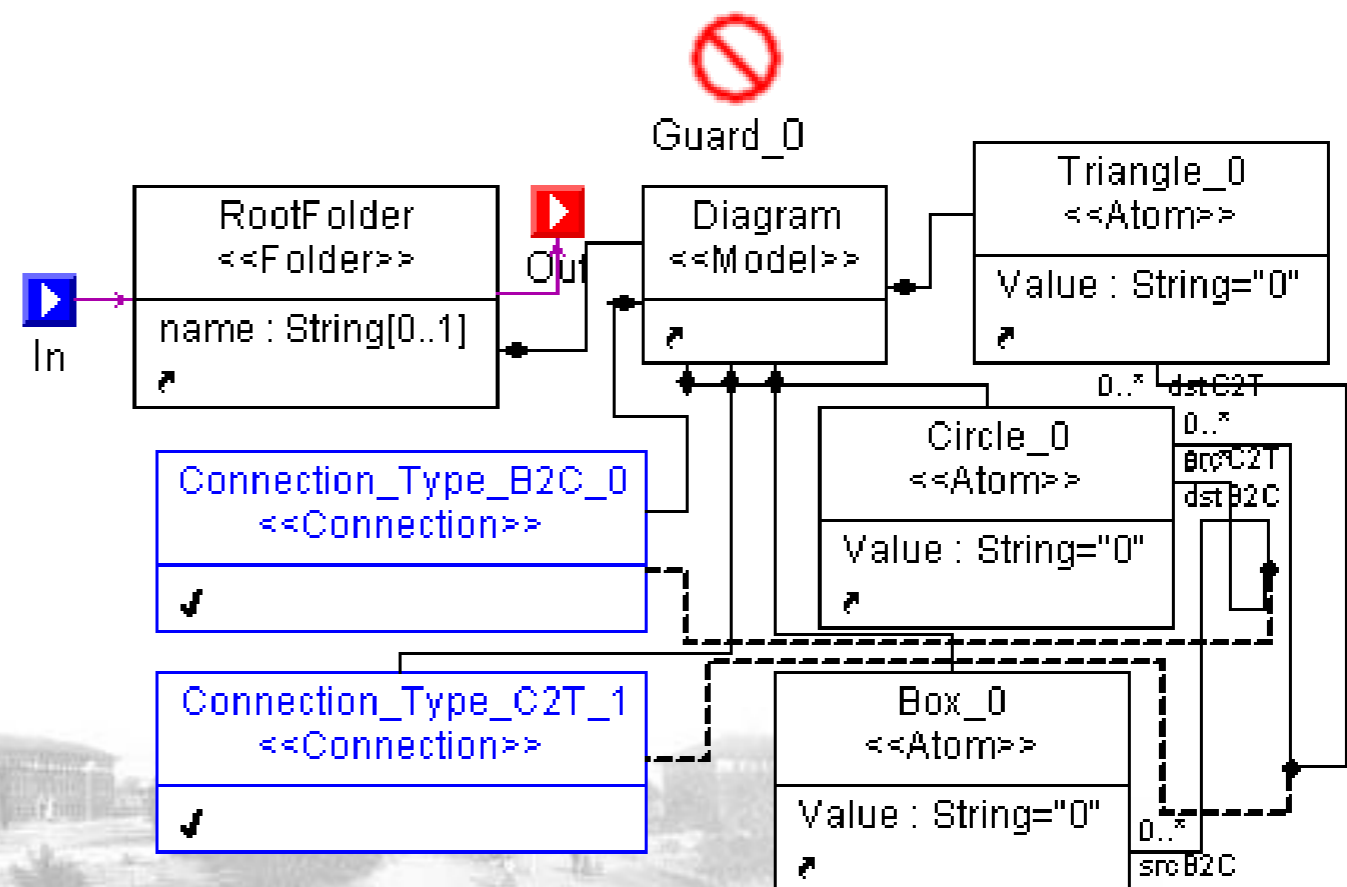
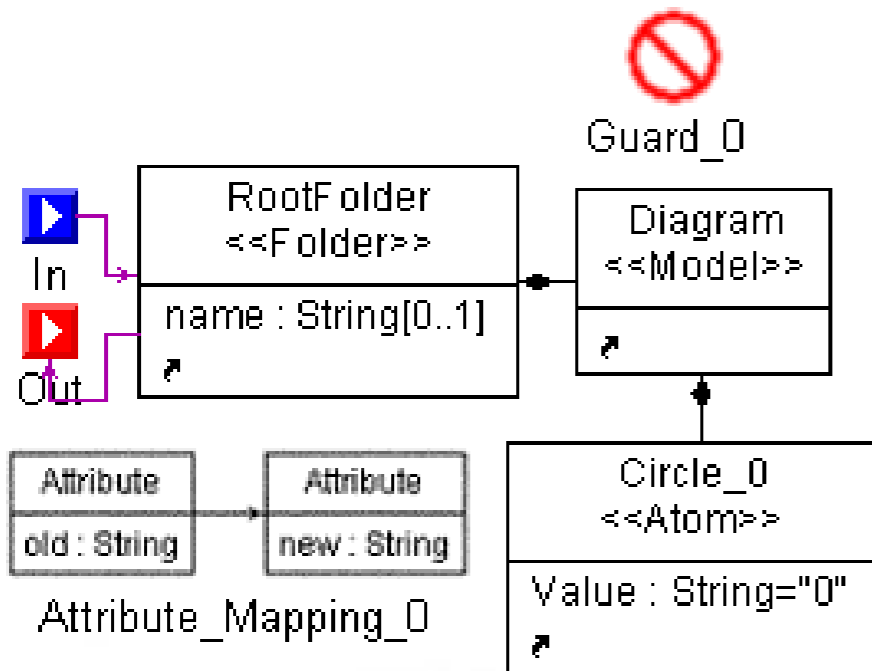


### Add New Elements

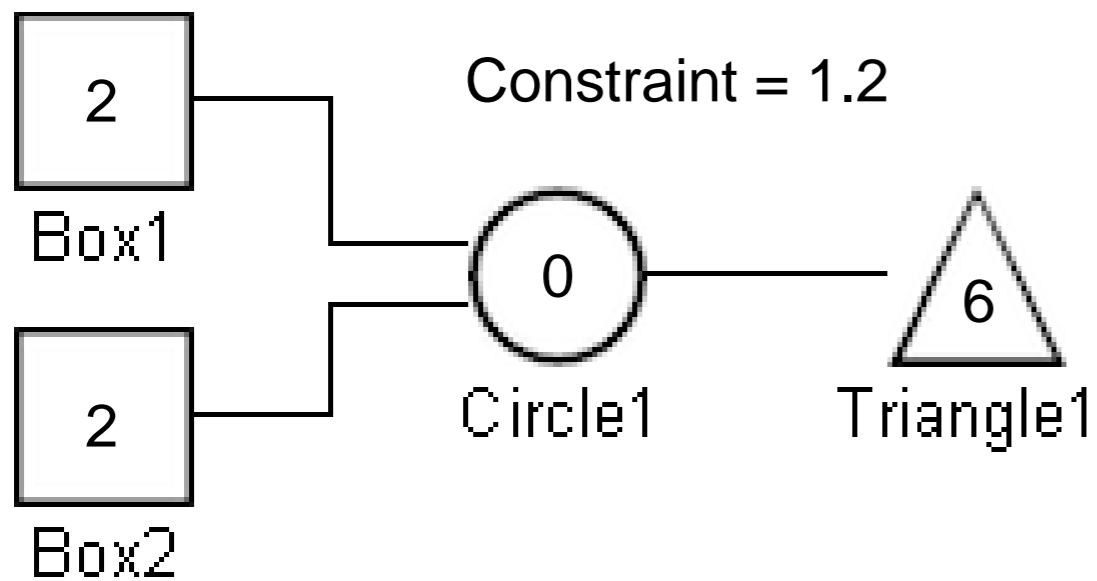


### Connect Existing Elements

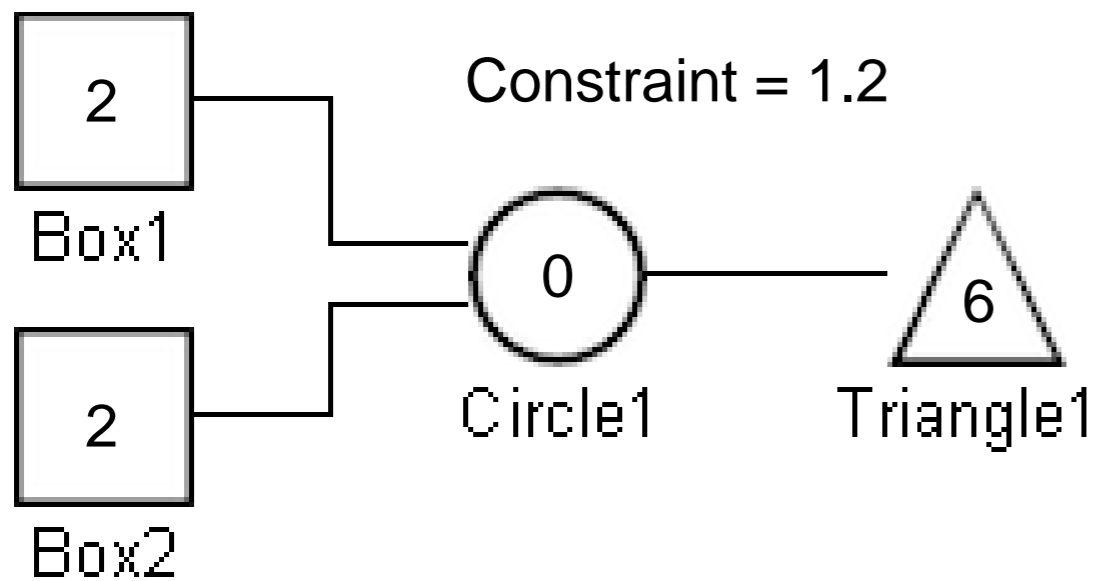
#### Alter Existing Elements



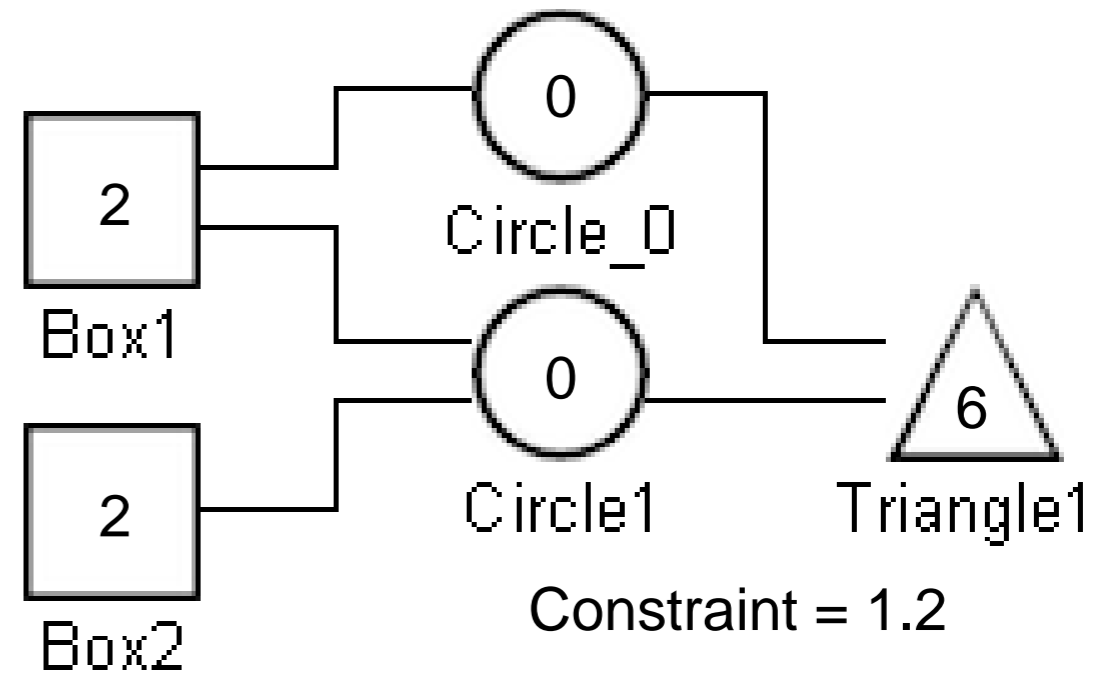




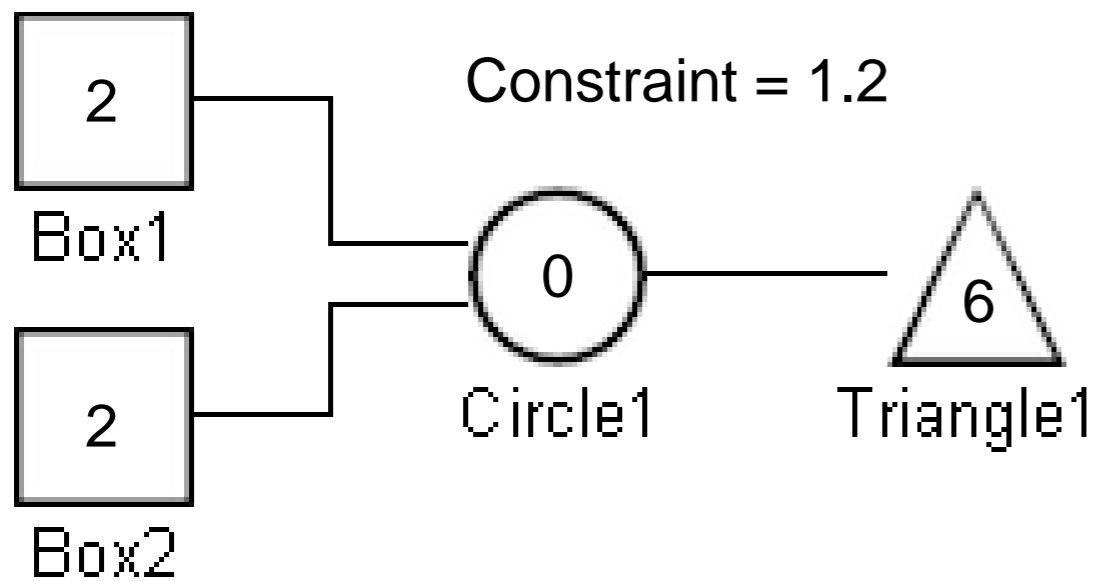
Original



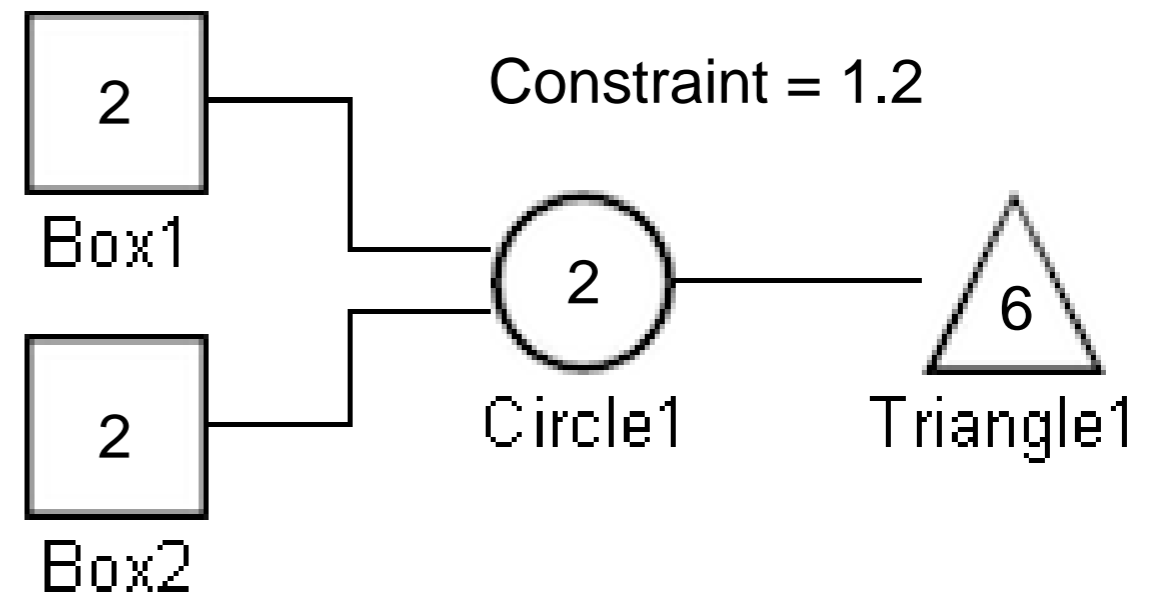
“Fixed” System



Original

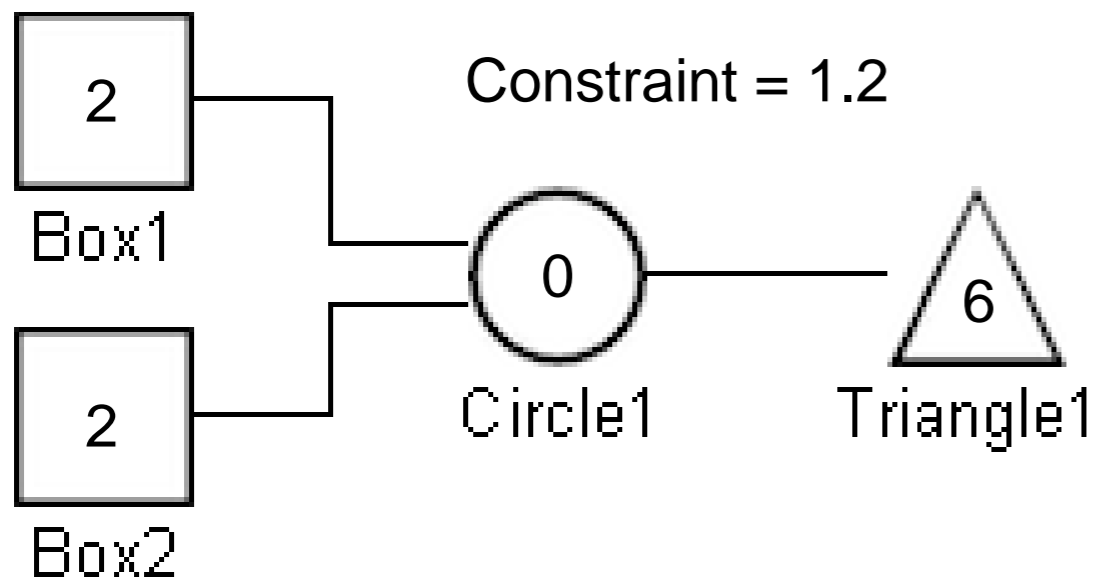


“Fixed” System

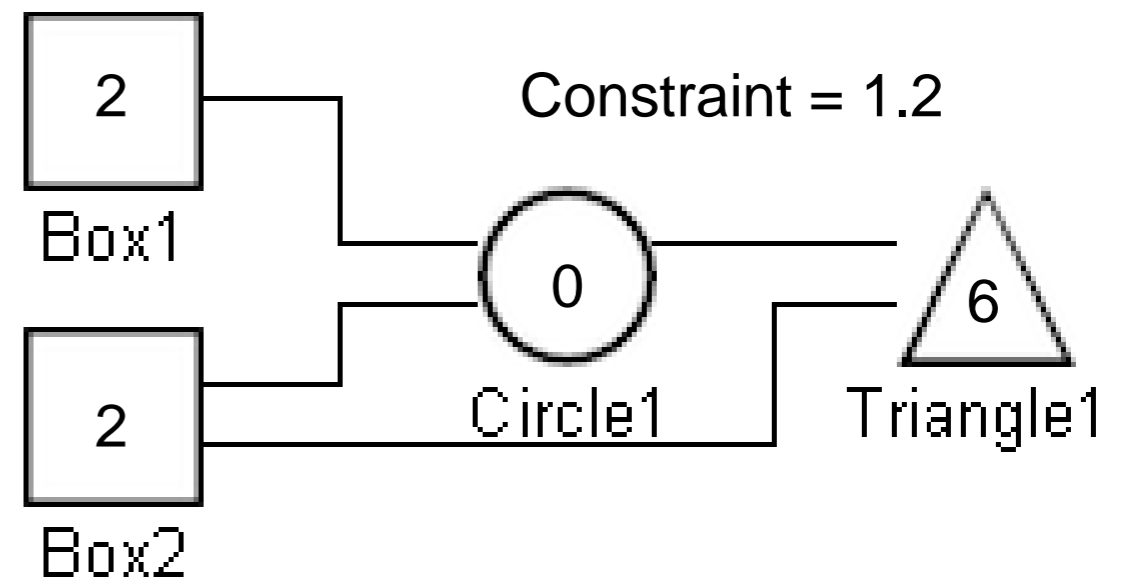


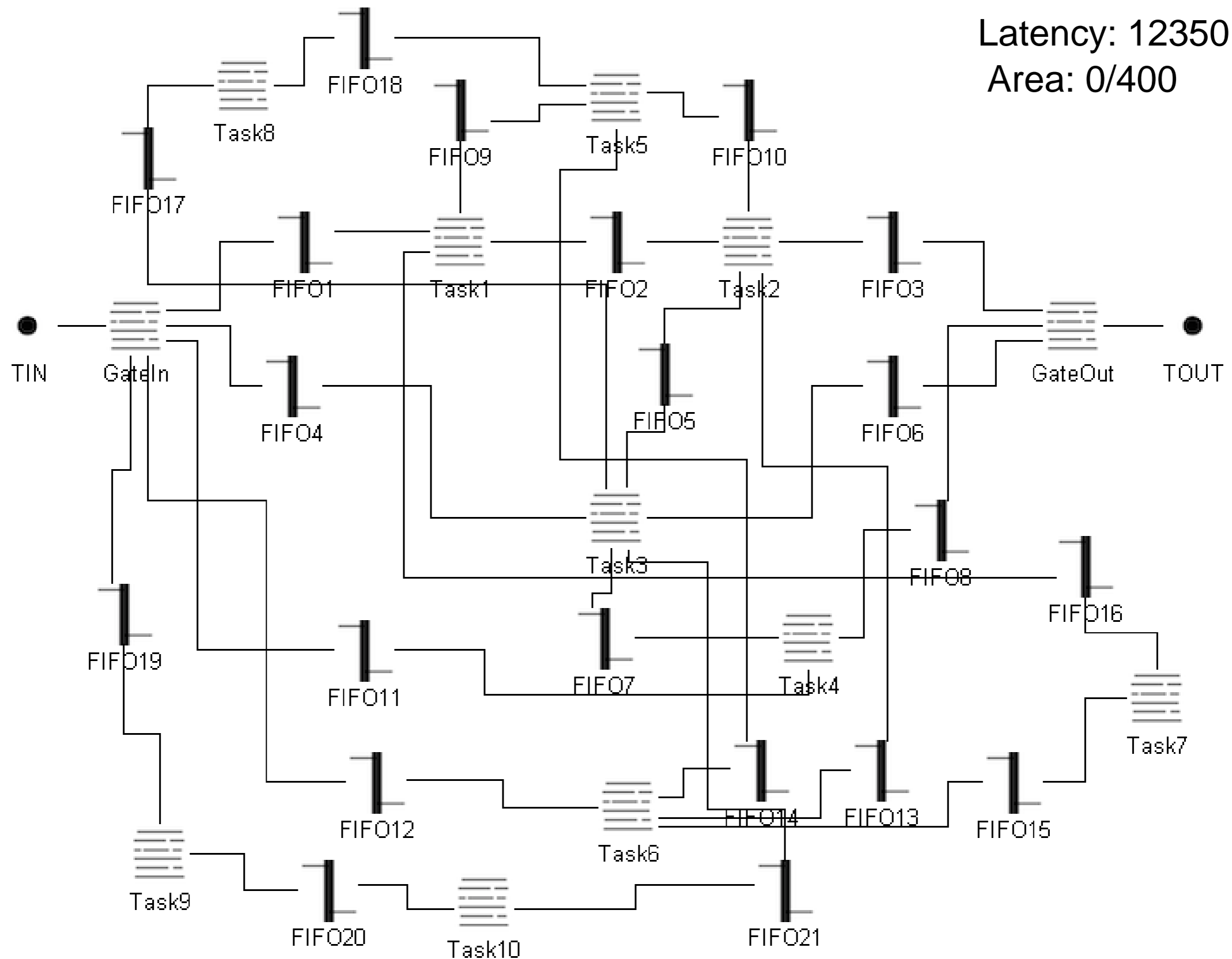


Original

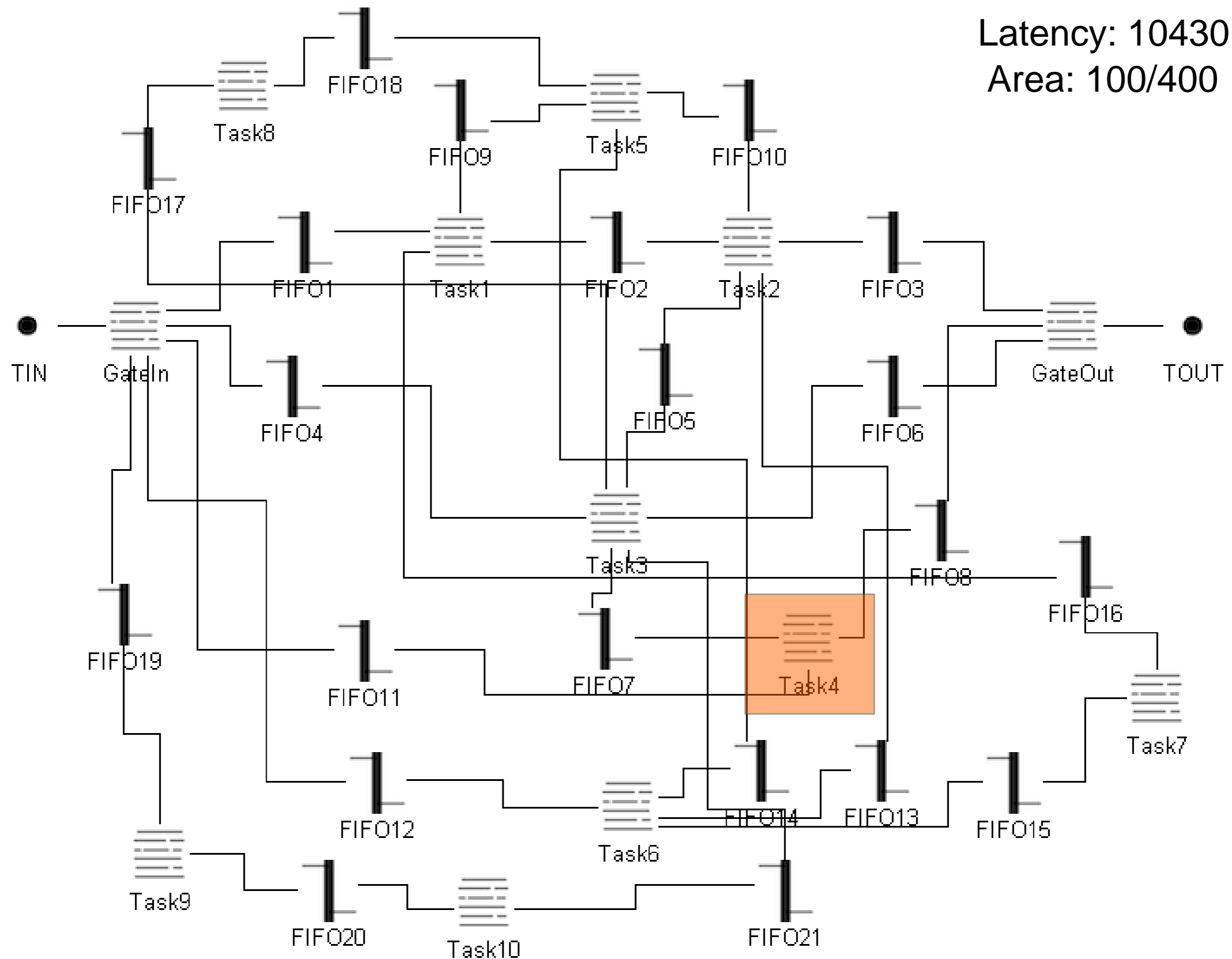


“Fixed” System

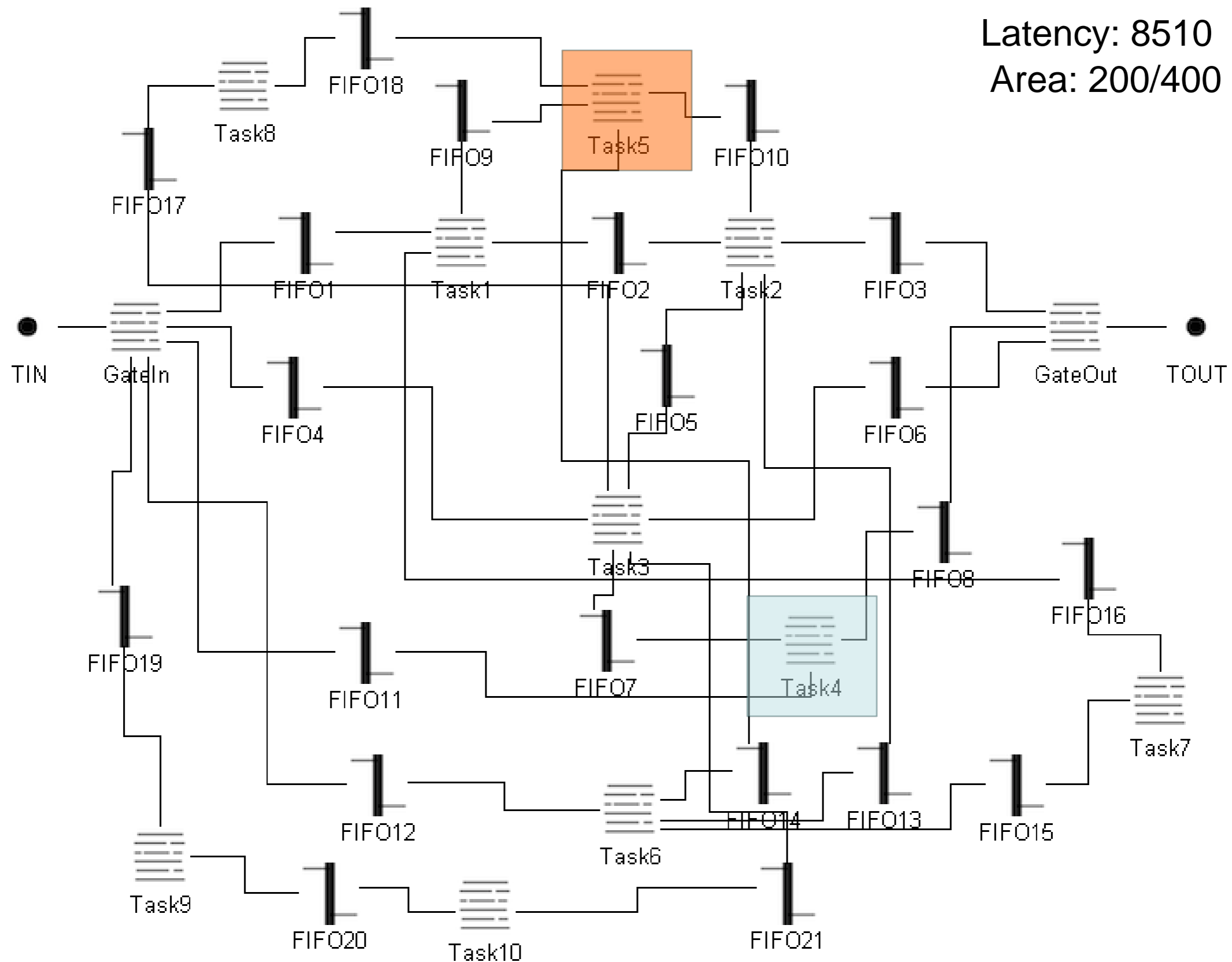




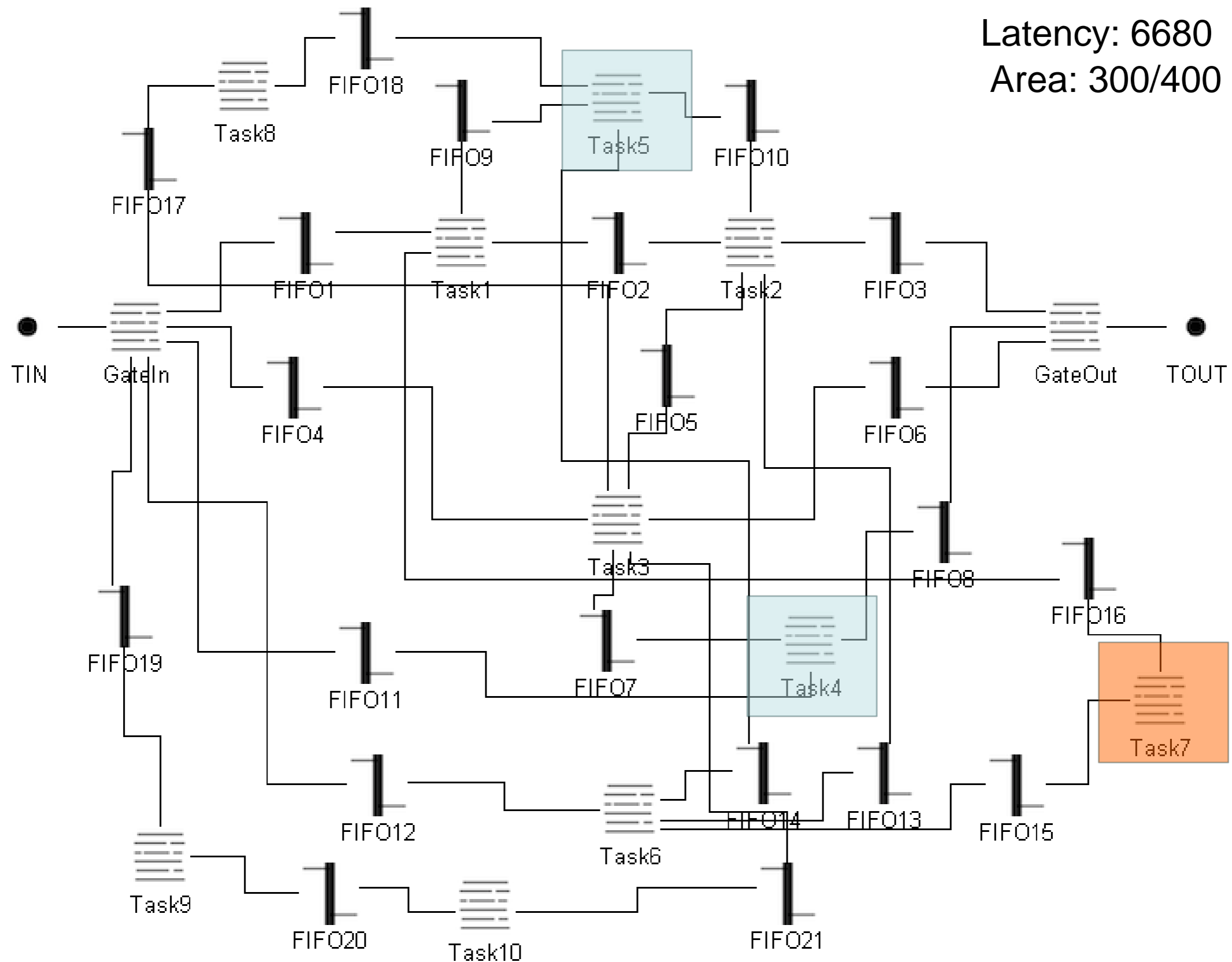
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Area: 0/400

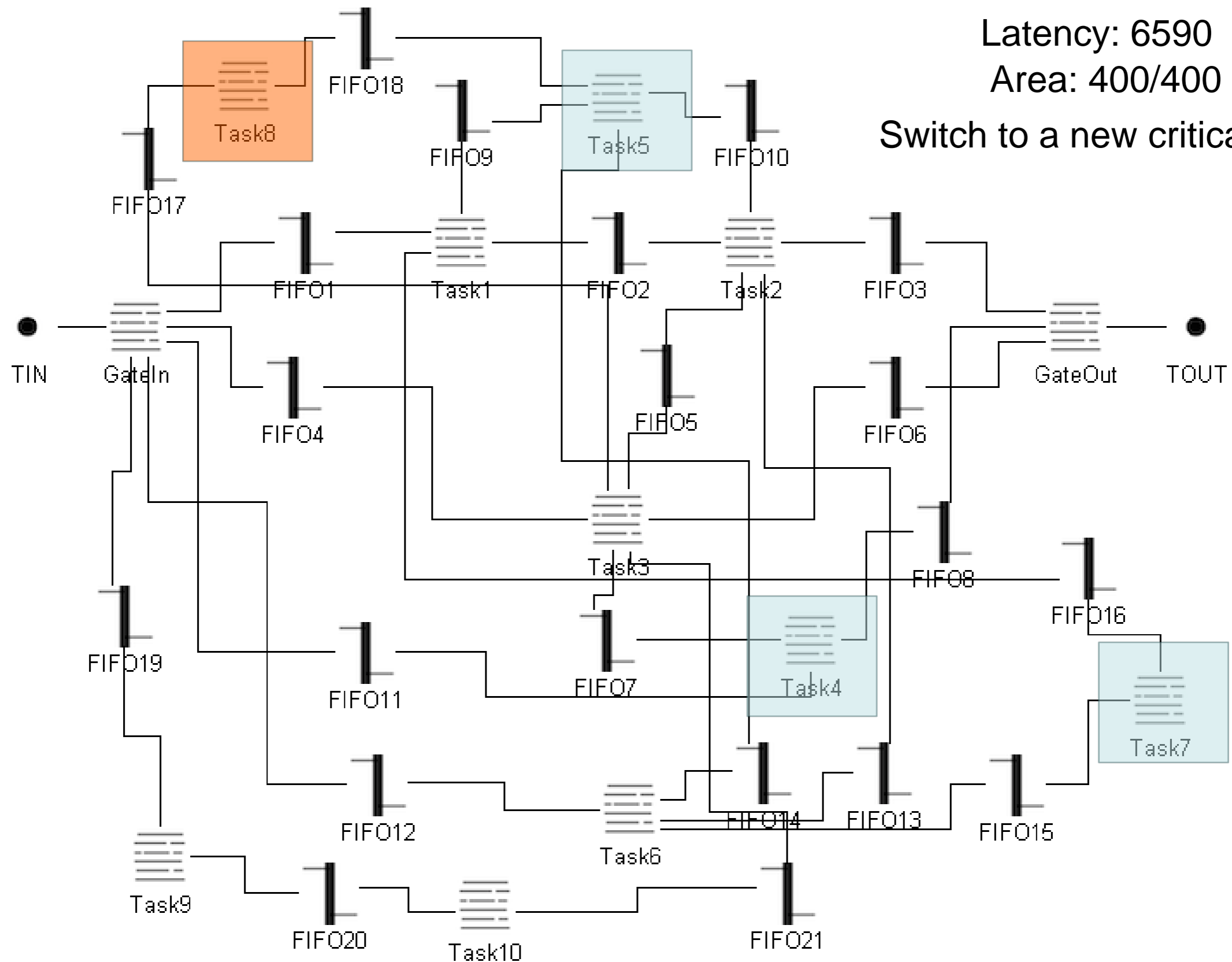






Latency: 8510  
Area: 200/400

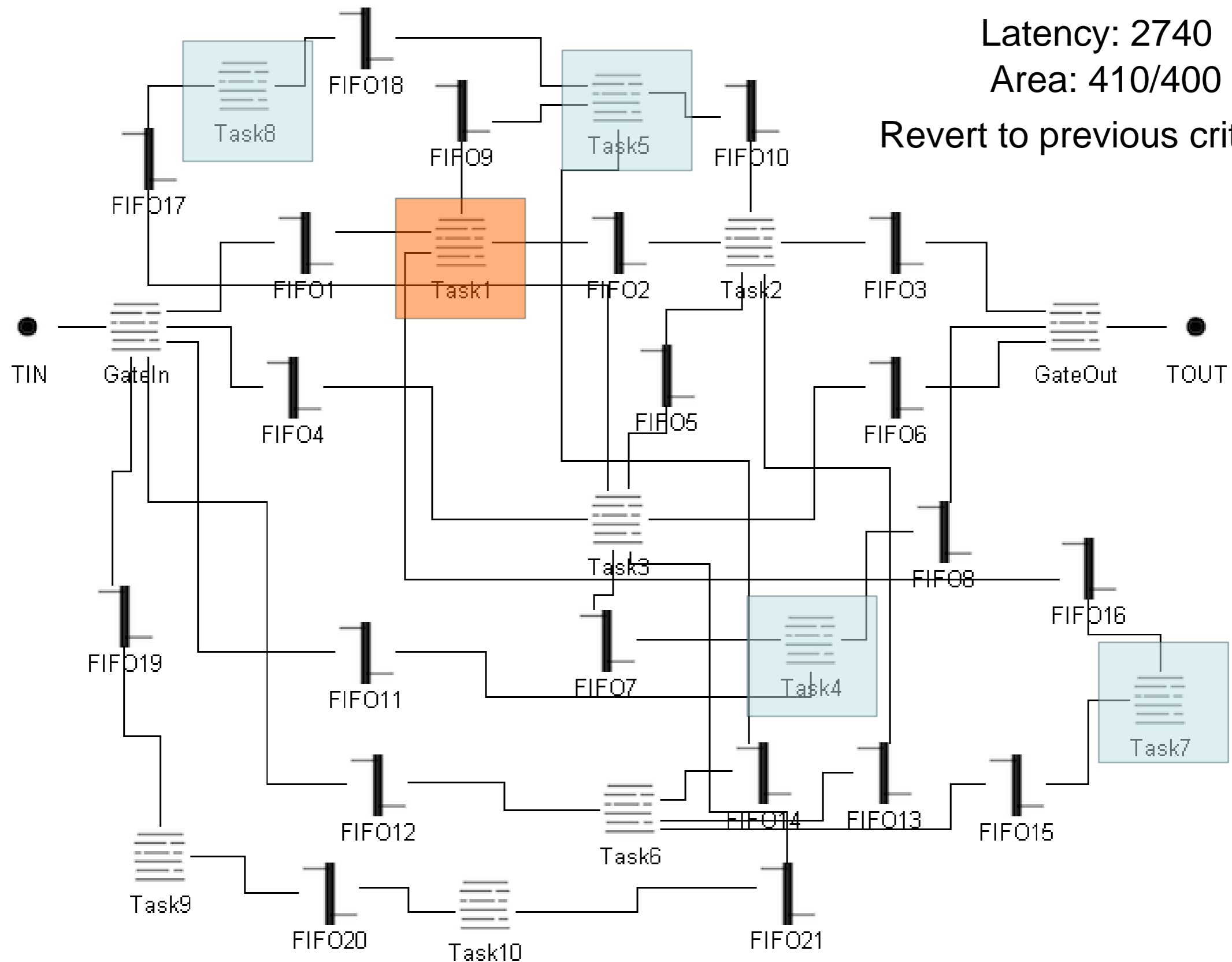




Latency: 6590

Area: 400/400

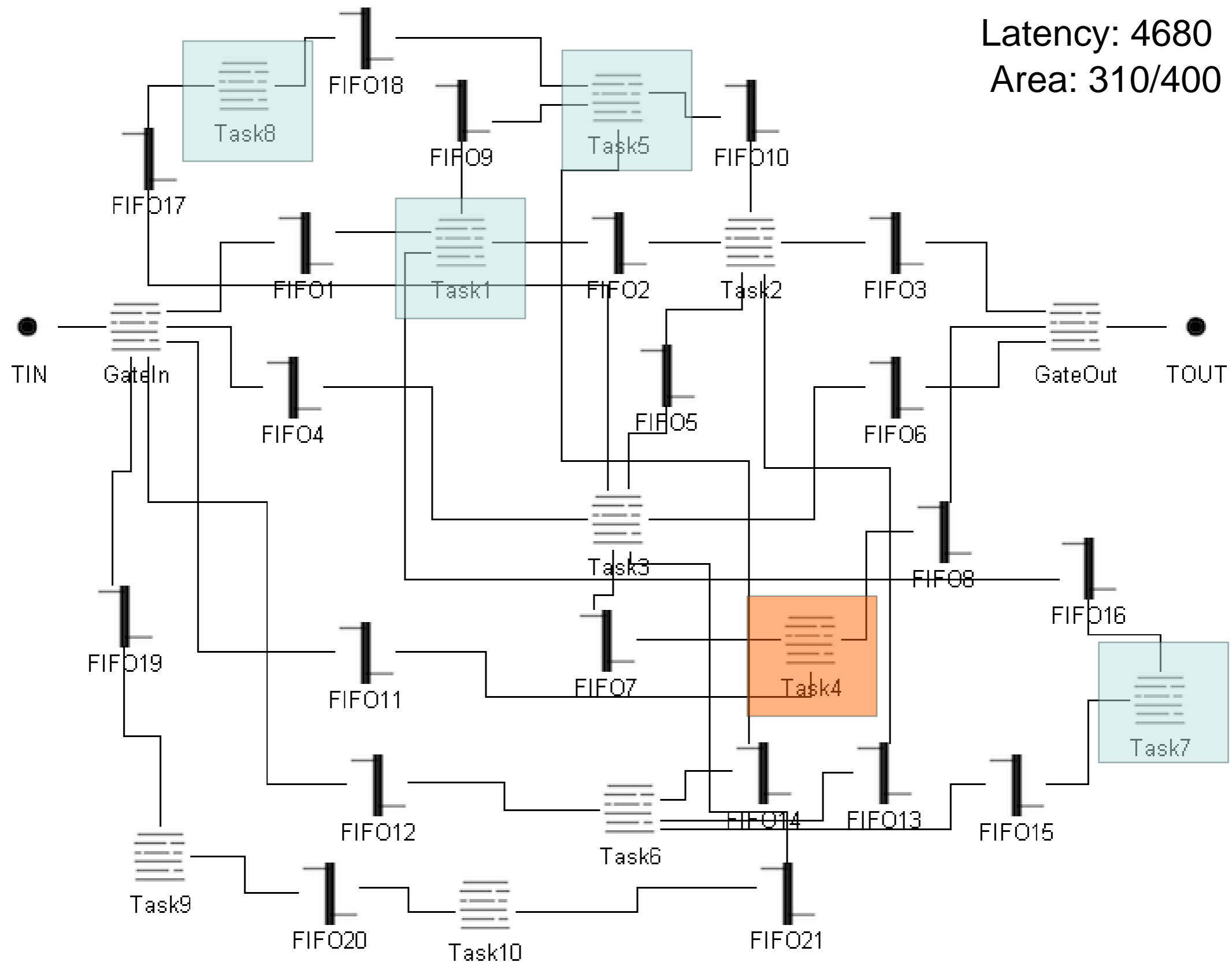
Switch to a new critical path



Latency: 2740

Area: 410/400

Revert to previous critical path





Questions?

