Model Scalability through a Model Recording and Inference Engine

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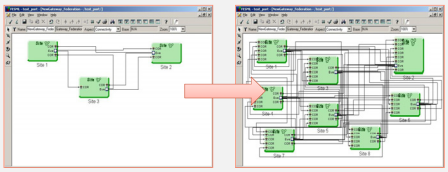
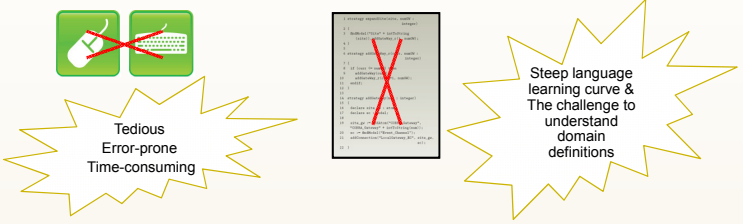
BACKGROUND

- Models used in software development often need to be scaled to satisfy the growing workload and system enlargement demands.
- How to scale up models from a base state to a complex state?



MOTIVATION

- The traditional approaches to scaling models are:
  - Manual editing
  - Writing model transformation rules

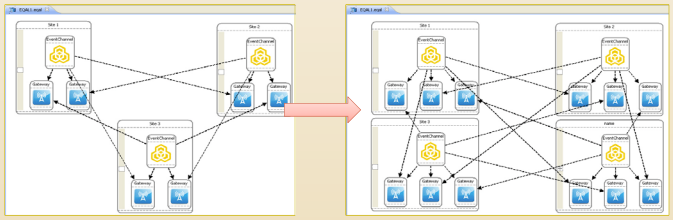


RESEARCH GOAL

- Design and implement a new approach to simplify the implementation of model scalability, so that general end-users are enabled to realize model scalability tasks in an automated manner, **without knowing any model transformation languages or metamodel definitions**.

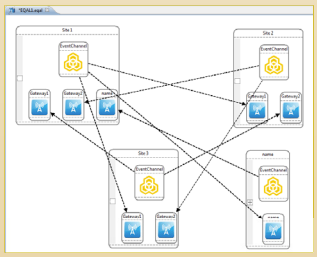
CASE STUDY

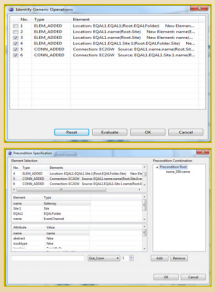
- The example is based on the **Event QoS Aspect Language (EQAL)**, a Domain-Specific Modeling Language (DSML) for graphically specifying publisher-subscriber service configurations for large-scale systems.
- The scaling task requires the addition of new *Sites, Gateways, Channels* and their corresponding *connections*.
- We select an instance with 3 sites, and demonstrate how to scale it up to 4 sites by manually adding new elements and updating attributes.



EQAL Model with 3 Sites *EQAL Model with 4 Sites*

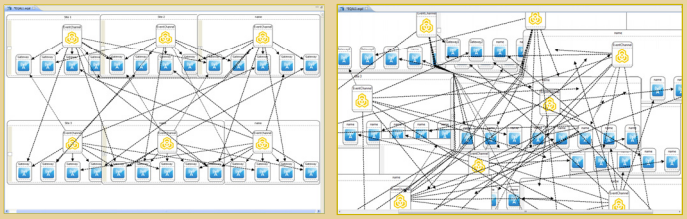
- **Demonstration in action**





- Identify generic operations
- Refine preconditions

- After the demonstration, users identify the generic operations that should be repeated according to the number of the elements in the source model, and give specific preconditions on the elements needed.
- The demonstration inference engine then generates the transformation pattern, which is capable of scaling up any number of elements generically.

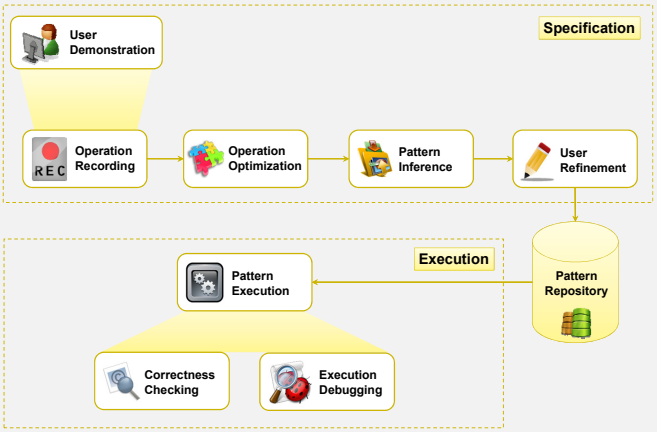


EQAL Model with 6 Sites *EQAL Model with 8 Sites*

Applying the generated pattern to scale up the model with more Sites

OUR APPROACH

- **Model Transformation By Demonstration (MTBD)** enables users to demonstrate how a model should be scaled by directly editing the source model to simulate the scaling up process step-by-step. During the demonstration process, a recording and inference engine captures all the user operations and infers the user's intention in a model transformation task, generating a transformation pattern that summarizes the precondition of a transformation (i.e., where a transformation should be done) and the actions needed in a transformation (i.e., how a transformation should be done). Users are also enabled to refine and modify the generated pattern to provide additional specific constraints in order to handle more complicated scalability requirements.



RESULTS & CONCLUSION

- No model transformation languages are used and the generated transformation patterns are invisible to users. Therefore, users are completely isolated from knowing a model transformation language and the metamodel definition.
- We have applied our approach to successfully implement several practical model scalability tasks in different domains, without writing any transformation rules or codes, showing improvement in the efficiency and simplicity.
- To evaluate the approach, the following provides a comparison of a model scalability effort that was performed using a model transformation engine (in this, case C-SAW), to that using MTBD.

Scalability Example	MTBD	C-SAW Language
Scaling up *Stochastic Reward Nets* Models	36 operations	170 SLOC
Scaling up *Event QoS Aspect* Models	17 operations	32 SLOC

- As future work, we will investigate how to ensure and check whether a demonstration truly reflects the desired scaling tasks, as well as how to debug the generated transformation.

This material is based upon work supported by the National Science Foundation under Grant No. CCF-1052616 (CAREER).