

**Autonomic Behavioral Aspects for Model-Driven Communication Applications**

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**I. Research Overview and Outcome**

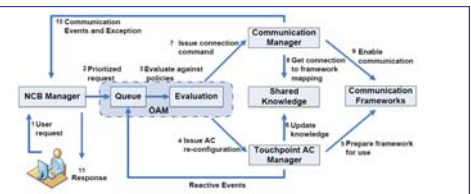
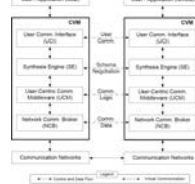
**Problem Statement**

Model Driven Development reduces the problem-implementation gap by redefining the role of models and using platforms for translating and realizing the application. Autonomic behavior (self-\*) are important properties for enhancing reliability, consistency and manageability in collaborative communication. A challenging problem is how to introduce autonomic behavior into the models for the platforms to support model driven development.

In this joint study project, the approach to the above problem will be to weave the adaptive behavioral aspects into the Network Communication Broker (NCB) of the Communication Virtual Machine (CVM). This will be implemented with the use of KERMETA, a meta-modeling toolset.

**Background**

The Communication Virtual Machine (CVM), shown below, is a model-driven paradigm for realizing collaborative communication



Network Communication Broker (NCB) is the layer of CVM responsible for providing a network independent API. The diagram above shows the conceptual flow for the autonomic NCB.

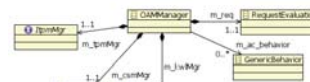
**Modeling with Aspects for NCB**

- ❖ Meta-models for each component of the architectural designs were developed.
- ❖ The meta-models were refined in a iterative cycle to add extensibility.
- ❖ Models were then created for the additional functionalities



KnowledgeSource Meta-model

**Modeling Using Kermeta**



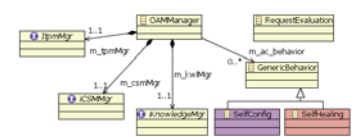
Orchestration Autonomic Manager Meta-model

Kermeta workbench is a powerful meta-programming environment optimized for meta-model engineering. It provides an environment for model and meta-model prototyping and simulation as well as aspect weaving.

Meta-models were created for components of the NCB such as the KnowledgeSource (shared knowledge used by the AC functions) and the Orchestration Autonomic Manager (coordinates actions on the managed resources).

The meta-model for the OAM includes a behavioral super class that extends behavioral function and semantics for the OAM. Policies, symptoms and change plans are accessed from the KnowledgeSource while the GenericBehavior class provide the semantics for effecting the behavior.

Self-configuration and self-healing autonomic behavior are weaved in as aspects to the base model.

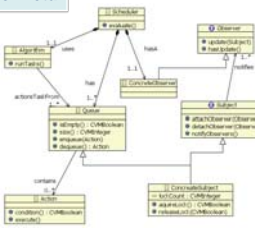


Orchestration Autonomic Manager Self Config model

**Challenges in Modeling Communication in Kermeta**

One issue identified in our work over the summer which warranted serious attention was how to effectively represent CVM's parallelism in Kermeta. Parallelism is an inherent property of communication intensive collaboration.

Effective simulation of CVM would therefore require this issue to be addressed. A concurrency metamodel was developed to solve this issue.



Concurrency Framework

End to end simulation of the NCB in Kermeta requires interfacing to communication frameworks such as Skype and Smack. These frameworks provide asynchronous data flow which would need to be supported by in a sequential executing Kermeta.

The concurrency framework will be extended to include a mechanism to queue up calls from the frameworks using an observer pattern.

**Future Work**

- ❖ Generalization of the concurrency framework for inclusion in TRISKELL repository.
- ❖ Develop a runtime reference model in NCB that can be utilized to support autonomic decision making
- ❖ Define service as the unit of adaptation
- ❖ One session, multiple services from multiple frameworks
- ❖ Full simulation of Autonomic NCB in Kermeta

**II. International Experience**



At work in Triskell Labs ...

Prehistoric Standing Stones in Carnac France

The PIRE program provided me with the opportunity for new experiences in collaborative research and European culture.

- PIRE provided the opportunity for professional development by:
- ✓ working with one of the foremost groups in modeling, the Triskell Team.
  - ✓ valuable feedback from the Triskell team members to augment my current research.
  - ✓ exposure to new research directions.

- PIRE also provided opportunity for personal development through:
- ✓ exposure to new cultures and customs.
  - ✓ Appreciation of cultural differences.
  - ✓ visits to historical sites.

At play...

The Thinker at Rodin Museum, Dining in France



Rialto Bridge in Venice, the Eiffel Tower at night

**III. Acknowledgement**

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