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Partnership for International Research and Education
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Pattern Based Fault-Tolerance at Workflow Management Systems

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I. Research Overview and Outcome

1. Motivation

❖ Complex workflows being used more often by scientists.
❖ Grid environments are being used to utilize resources in multiple organizations.
❖ Heterogeneity and dynamicity of the environment introduces challenges to the execution of workflows.
❖ If not handled, these challenges may result in wasted time and resources, and basically unsuccessful execution of workflows.
❖ Scientists need reliable tools to successfully conduct their business.
❖ Administrators are concerned with the utilization of resources.

2. Our Approach

Two-layer approach:
➤ **Job-flow Manager** for orchestration of dependent jobs.
➤ **Meta-scheduler** for deploying, monitoring and execution of individual jobs.
**Fault-Recovery:**
➤ First, we identify and label **job flow patterns** within a job flow during deployment time.
➤ Next, at run time, we introduce the **Transparent Proxy**, which intercepts and resolves faults using job flow patterns and their corresponding fault recovery policies.
Advantages of our Approach:
➤ Separation of job flow and fault handling logic.
➤ Flexibility of defining job flow patterns, fault patterns, and recovery strategies as late as deployment or runtime.
➤ Tailoring of recovery strategies based on installation specifications without changes to the application flows.
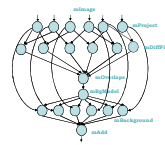
3. Architecture
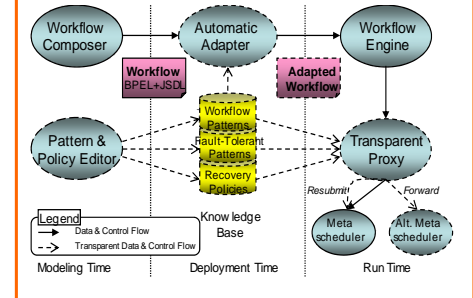
4. Implementation

❖ **A Typical Job-flow Pattern:**

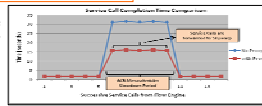❖ **Re-Poll Status Pattern:**

❖**Case Study:**

❖**Software Used:**
• ActiveBPEL flow engine,
• Globus Toolkit,
• GridWay Metascheduler
❖**Hardware Used:**
• GCB (8 node cluster),
• Skywarp (single node)

5. Experimentation

➤ Average total service calls completion time for successive calls.

➤ Runtime table for 5 different simulations of the Montage workflow. Number of "Retry Job", "Redirect" and "Retry Operation" patterns applied by the proxy is given for each service and each fault type.

6. Accomplishments

❑Integration of Job-flow Manager with underlying Meta-scheduler.
❑Pattern-based fault recovery knowledge base, which is expandable and separate from business logic.
❑Adaptation of Generic Proxy for long-running Grid jobs for transparent fault-handling.
❑Montage application case study and experimentation results show the effectiveness of our implementation.
❑Following paper has been accepted for publication:
Selim Kalayci, Onyeka Ezenwoye, Balaji Viswanathan, Gargi Dasgupta, S. Masoud Sadjadi, and Liana Fong. **"Design and implementation of a fault tolerant job flow manager using job flow patterns and recovery policies."** In Proceedings of the 6th International Conference on Service Oriented Computing (ICSOC'08), Sydney, Australia, December 2008.

II. International Experience

1. IBM IRL

❖ Pretty nice and comfortable place, also warm and friendly working environment.
❖I was given a cubicle to work, and a laptop to work. Also, several other hardware resources were made available for me to conduct my research.
❖There were approximately 30 interns as me in Summer, mostly local Indians, and a few internationals.
❖Smart, talented, and benevolent mentors and collaborators, **Gargi Dasgupta** and **Balaji Viswanathan** (in the picture below), were with me and guided me in every step of my work during the program.
❖Also, being in IRL helped me to conduct my work on the IBM resources that were made available to me, which was essential in our project.

2. Dos and Don'ts in India

❖Don't eat or drink water from any random places.
❖Don't just give the money requested by merchants, like taxis, gift shops, etc. DO Bargain, and ask people you know to help you about the expenses of certain items you would need to purchase. And negotiate on the price before you are given the service to avoid confrontations.
❖Be careful with the kind of food you are going to eat, ask locals to help you.
❖When you are outside, carry your belongings with you all the time, and be watchful for your wallet, or whatsoever.
❖If you are visiting in Summer, you should know that it gets very hot, so take precautions, especially when you are going to do sight-seeing.

3. Places to Visit in India

❖In New Delhi, you should go to India Gate, Humayun's Tomb, Lotus Temple, Red Fort, Lotus Temple, Qutub Minar. You can also go to Gurgaon, which is about 20 miles from New Delhi, to visit malls and company headquarters.
❖You should ride the newly constructed subway, just for fun. It is very cheap also.
❖For local shopping and diners, you can visit Khan Market or Connaught Place.

India Gate   **Humayun's Tomb**   **Lotus Temple**

❖Besides New Delhi, there are quite many places you can visit in India. First of all, you should definitely see TAJ MAHAL. It is in Agra, which is about 4 hours away with a train ride. Once you go there, you should also see the magnificent Agra Fort right across Taj Mahal.
❖In summer, to get some cool and fresh air, you can visit some of the hill stations in India. There are many of them. I visited only Mussoorie, and I can totally recommend it. Such another hill-station is the place called Shimla.
❖Some other places I would like to recommend: Jaipur, Himalayas, Goa, Mumbai.

Taj Mahal   **Agra Fort**   **Mussoorie**

III. Acknowledgement