Pattern-Based Multi-Cloud Migration

Context and Background
Cloud migration allows companies to benefit from the cloud’s promise to reduce capital expenditure, transforming it to a ‘pay-as-you-use’ model, while simultaneously increasing the scalability, flexibility and resilience of their IT infrastructure. One of the most critical steps in the migration process is the selection of the most suitable cloud architecture for the applications to be built in the cloud. The ability to choose a cloud architecture from a catalogue of existing migration patterns will help companies; i) to choose the most suitable cloud platform to use, ii) to reduce the risk of migration failure and iii) to more accurately estimate the cost and time to deliver the migration project.

As IT increasingly permeates business processes, resulting in complex, integrated, software solutions, no one cloud architecture or migration framework/process/strategy will meet all business needs. For example, in migrating to the cloud companies might decide to deploy their application on multiple cloud platforms, either private cloud or public ones, in order to leverage particular cost, performance or security features that are important for a specific application. Similarly, companies may also decide that some legacy applications need to be retained, for either contractual, security or cost reasons, on on-premise equipment creating a need for solutions that can interoperate between the on-premise equipment and the cloud. Finally, a one-step migration from on-premise equipment to the cloud is often not desirable or practical from the perspective of reducing migration risk, reducing operational costs or disrupting on-going business processes. The possibility to ‘burst’ into the cloud, when workloads get too large for existing on-premise equipment, is often the most operationally efficient and least disruptive first step of expanding IT resources. This means that a migration pattern may consist of a number of interim architectural steps.

One of IC4’s research themes is focused on improving the process of migrating legacy on-premise software to multi-cloud environments and we plan to develop a catalogue of migration patterns to help companies to plan and execute such migration projects. The multi-cloud deployment is particularly effective in dealing with the following challenges:

- Users are widely distributed where they are located around multiple data centers.
- Country regulations limit options for storing data in specific data centers, e.g., EU.
- Circumstances where public clouds are used jointly with on-premises resources.
- Cloud-based application must be resilient to the loss of a single data center.

IC4 Research Focus
IC4’s research addresses how to reorganize multi-tier, multi-component applications into disjoint groups of components, such that each such group can be deployed separately in different platforms (i.e., cloud platforms, on-premise platform) while preserving and in most cases enhancing the desired properties of the application. We have devised fine-grained cloud migration patterns, extracted based on empirical evidence from a number of migration projects, best practice for cloud architectures and a systematic literature review. The fine-grained migration fragments allow application developers and architects to plan the migration and communicate the plan and the decision with non-technical stakeholders. The patterns define the architectural change in the application deployment setting, showing the sequence in which an application is migrated to a single or multi-cloud platform. A migration plan is defined as a composition of selected patterns for specific situations.

The Migration Pattern shown in the diagram below is an example of how two integrated applications running on an on-premise platform can be re-architected so that one application (e.g. for data privacy reasons) may be kept on the on-premise platform while the second application can be migrated (e.g. for performance reasons) to run simultaneously on geographically separated cloud platforms. This can be achieved without compromising the ability of the applications to communicate with each other.
Who Cares?
IC⁴ believes that this research will be of interest to a range of organizations;

- Cloud Platform Providers or Resellers who want to demonstrate a migration methodology to target customers in a language they can understand.
- CIOs of organizations who are planning a process of migrating their IT infrastructure to the cloud
- Independent consultants and system integrators who help organizations to plan and execute a strategy for migrating IT infrastructure to the cloud.

These organizations share the goal of developing cloud-based solutions that address the following concerns:

- **Availability.** Cloud environments typically provide customers with a SLA, which means that applications must be architected to guarantee maximum availability.
- **Management.** Cloud environments provide runtime information that enable administrators to monitor the system and support on-the-fly changes.
- **Scalability.** Cloud environments enable applications to scale out to meet bursts in demand, and scale in when demand decreases.
- **Resiliency.** Cloud environments provide the ability for a system to gracefully handle and recover from failures.

Research Approach
IC⁴ would like to work with companies who are migrating applications to private, hybrid and public cloud platforms for the purpose of validating, through detailed migration expert interviews, that the developed catalogue of migration patterns are applicable or if additional migration patterns or more fine-grained patterns need to be developed to cover some cloud platform architectures. These will cover IaaS, PaaS and SaaS migration projects.

Benefits for Involved Companies
IC⁴ has already devised a repository of 15 cloud migration patterns. Through this process, we can identify concrete examples of pattern usage in practice and evaluate the usability and completeness of our migration repository. We will then allow companies that have been involved in this process to instantiate and use our repository for facilitating the migration planning in their projects. We believe that this repository will help them to provide a migration plan that can be communicated with non-technical stakeholders and get them closely involved in the migration process from planning down to execution and evaluation. We will also provide an engineering process for companies to (i) select appropriate patterns based on their objectives, (ii) compose them to define a transparent migration plan, and (iii) extend them based on the identification of new patterns by applying them to new contexts. We believe that this repository would enhance the current migration practices in Irish consultancy companies.
Further Details