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Autonomic Computing using clouds

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Abstract:
In this paper, we have explained a set of architectural characteristics to manage systems where complexity is increasing but must be managed without increasing costs or the size of the management team, where a system must be quickly adaptable to new technologies integrated to it, and where a system must be extensible from within a corporation out to the broader ecosystem and vice versa. The primary goal of autonomic computing is that "systems manage themselves according to an administrator's goals. New components integrate …effortlessly ..."i. *Autonomic computing* per se may have been viewed negatively in the past years — possibly due to its biological metaphor or the *AI* or *magic-happens-here* feel of most autonomic initiatives. But innovations in cloud computing in the areas of virtualization and fine grained, container-based management interfaces, as well as those in hardware and software, are demonstrating that the goals of autonomic computing can be realized to a practical degree, and that they could be useful in developing cloud architectures capable of sustaining and supporting ecosystem-scaled use.

Keywords: Cloud Architecture, autonomic computing, policy pushdown, virtual organization

Introduction:

Cloud computing offerings today that are suitable to host enterprise architectures. But while these offerings provide clear benefit to corporations by providing capabilities complementary to what they have, the fact that they can help to elastically scale enterprise architectures should not be understood to also mean that simply scaling in this way will meet twenty-first-century computing requirements. The architecture requirements of large platforms like social networks are *radically* different from the requirements of a healthcare platform in which geographically and corporately distributed care providers, medical devices, patients, insurance providers, clinics, coders, and billing staff contribute information to patient charts according to care programs, quality of service and HIPAA constraints. And the requirements for both of these are very different than those that provision *straight-through processing* services common in the financial services industry. Clouds will have to accommodate differences in architecture requirements like those implied here, as well as those relating to characteristics we subsequently discuss.

To satisfy the requirements of next century computing, cloud computing will need to mean more than just externalized data centers and hosting models. Although architectures that we deploy in data centers today should be able to run in a cloud, simply moving them into a cloud stops well short of what one might hope that Cloud Computing will come to mean.

Next Generation Clouds

To satisfy the requirements of next century computing, cloud computing will need to mean more than just externalized data centers and hosting models. Although architectures that we deploy in data centers

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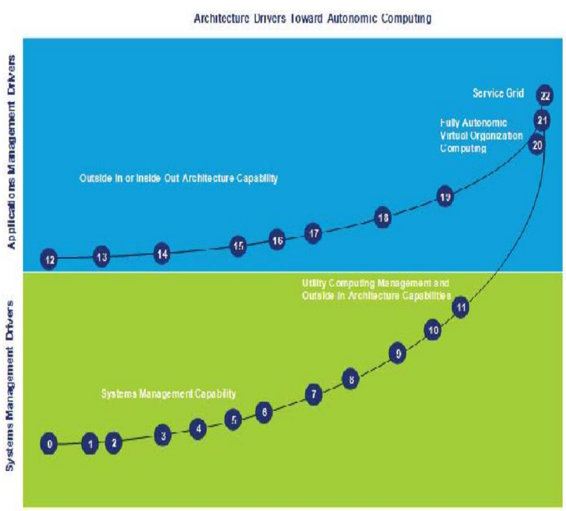
today should be able to run in a cloud, simply moving them into a cloud stops well short of what one might hope that Cloud Computing will come to mean. In fact, tackling global-scaled collaboration and trading partner network problems in military, scientific, and business contexts will require more than what current architectures can readily support.

The coarse-grained characteristics, sometimes described as *autonomic computing*, can be represented in the form of finer-grained architecture drivers that are useful in characterizing steps *toward* an autonomic computing architecture. Cloud Computing offerings that are available today share many of the same drivers that we have organized into *Systems* and *Application Management Drivers* in the figure below.

Numbered circles in the graphic above denote drivers that are listed below:



Policy Engine

A Policy Engine harmonizes and adjudicates conflicting policies used across architecture layers. Components at all architecture layers can participate in policy harmonization and enforcement, which requires the following:

- Policy extension points must be exposed and formally declared in any part of the architecture that must be managed.
- Policy management must support *policy pushdown* to enable extensible

and dynamic detection of policy violation and policy enforcement.

- It must be possible to version policy so that policy decisions made at a given time can be reproduced.
- Policy exceptions should be managed in as automated a fashion as possible, but support also must be given to cases where human judgment and decision making may be required. Note that *fault* or *exception* can connote both system-level occurrences *and* domain evolution in which policy constraints valid in the past become invalid. For example: Inability to connect to a database is a system fault that should be automatically handled as a software system exception.

- A regulatory constraint that permitted conduct of business in one way to a certain point in time, but that no longer does due to changes in law, is a business exception that may require human judgment to determine if completion of a business transaction according to old law should be permitted.

Policy embedded in application functionality is not easy to change, but future software systems will have to be implemented in a way that views change as the norm — where change results from the emergence of new markets, market evolution, changes in regulations and standards, fixing of policy bugs, the whims of interaction participants, and maybe even their customers' whims.

Virtual organizations and cloud computing

General Social networks are examples of platforms that use a somewhat amorphous definition of *organization* similar to a *virtual*

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organization, which is defined by the National Science Foundation as "a group of individuals whose members and resources may be dispersed geographically and institutionally, but who function as a coherent unit .Virtual organizations can form in a variety of ways, usually as a function of roles/responsibilities played in interactions and less as a function of title or position in an organization. Roles/responsibilities represent interfaces that have interaction scope and can be used to automate computing and exception handling .

Conclusion:

Autonomic computing, can be sensibly applied to Cloud Computing in a way that will be useful when developing cloud architectures capable of sustaining and supporting ecosystem-scaled platforms. We suspect that this will become the norm as adoption of cloud computing increases and as social network platforms transition to include business capabilities.

Cloud computing as we see it emerging today is somewhat generously defined, making it difficult to form a point of view about the capabilities of currently available cloud computing instances to manage next century platforms. While it is clear that they can manage today's common platforms, we see architectural challenges for the future that we believe will be difficult to address using current cloud architectures and architecture styles. We identify technical challenges — including architecture style, user and access control management, the need to have externally managed business and infrastructure policies through interaction containers, and the need for Utility Computing capabilities — that must be addressed to meet future architecture requirements.

Aiming at implementation of an *ecosystem* platform will take us beyond the management capabilities of current cloud offerings. Adding architecture components like the interaction container and externalized policy engine will improve cloud capabilities, but until these become fundamental components in cloud architecture, it is unlikely that a cloud will be able to manage the concerns of a service grid. It is interesting to note, however, that the construct of a service grid enables it to manage the concerns of a cloud.

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