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Infrastructure Organisms: Automating Management Feedback. Infrastructure and application management (IAM) is evolving from unidirectional monitoring and control to adaptive systems, stabilized by information feedback loops. Self-regulation and other organic characteristics are beginning to appear in sophisticated infrastructures via IAM technologies and services.

META Trend: During 2001-03, proliferation of e-business component infrastructure and application architectures will drive meta-management approaches to meet cross-boundary (e.g., organizational, informational, technical) requirements for status aggregation, coordinated policy control, processes, etc. Extensible Markup Language (XML) will emerge as the desired management data exchange layer by 2003/04, and customized management portals will appear by 2004/05 in all tool and service offerings.

Most current infrastructure and application management (IAM) efforts are limited to fault and performance monitoring and notification, with little actual adaptive management. The task of reacting to exceptions is largely a manual process, employing the skills and heuristics of the IT staff. True management requires automating this reaction to performance and fault information. IAM developments have made impressive progress toward reducing reaction time, but genuine proactive management has been elusive. The eventual goal is to further evolve these management systems to finally realize actual proactive and dynamic systems.

Feedback loops are a common form of regulating the behavior of dynamic systems (e.g., preventing the squeal in a public-address system, regulating heartbeat with a pacemaker). If IAM is to realize its potential, similar feedback mechanisms are required. The infrastructure management process already employs this mechanism, but it is excessively manual and notoriously slow. It requires human intervention as the medium to carry out the feedback process. Automating this human intervention is key to evolving infrastructures toward adaptive entities with the ability to stabilize their own behavior. Such dynamic infrastructures begin to resemble self-regulating characteristics of biological organisms, so we call them *infrastructure organisms*.

Through 2002, technology developments for adaptive control will be abundant, with solutions maturing to early adopters by 2003 and going mainstream by 2005. Comprehensive pseudo-organic behavior is envisioned during the latter half of the decade. During the next 12 months, the coalescence of existing technologies (e.g., rules-based engines, performance/fault monitoring, topology discovery) will yield preliminary results. By 2002/03, integrating IAM systems with service providers' automated controls will expand dynamic control beyond traditional enterprise boundaries. Standard messages based on XML will eventually be required, but they will not be robust until 2004/05. Progressive service providers will support proprietary XML control messages earlier.

Cultural resistance, based on obsolete silo-centric operations, will be the main barrier to widespread adoption of these systems. Because operational processes supporting end-to-end management efforts are such an important aspect of the infrastructure organism, any focus on silo management must be transformed to reinforce these efforts. Structured operational process models (see SMS Delta 943, 23 Oct 2000) are now driving the eventual removal of these barriers. A process model for a closed-loop management system is shown in Figure 1 (see Addendum). Most current IAM systems mainly

Business Impact

IT organizations should redirect energy and resources to a more strategic, business-centric focus instead of a reactive, tactical focus.

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implement the monitoring and reporting processes. Exception notification is considered a progressive step, but very few environments automate the configuration and change management processes. Although it is impossible to automate these processes 100%, users should strive to maximize the level of automation.

Many of the elements are already in place to conquer the technical issues of fault detection, performance degradation, and control mechanisms. Systems need to aggregate these elements, map their relationships, and execute according to sensible operational processes. Fault and performance management systems have matured to the point where root-cause identification is now becoming common (e.g., SMARTS, Aprisma, Micromuse, RiverSoft). The next step in this evolution will initiate rudimentary actions based on these detected events. Actions will initially employ simple, yet mature, rules-based engines similar to those used for years in systems automation (e.g., NetIQ's AppManager, Concord's SystemEdge, HP's OpenView Operations). Management software vendors are beginning to address more sophisticated automation of the feedback loop from a technology perspective. Initial offerings from Peakstone, Quantiva, ProactiveNet, Opticom, and Dorado monitor and attempt to learn behavior patterns from the infrastructure. The systems then exploit intelligent control facilities embedded within the infrastructure to complete the loop. These adaptive control features are far from complete, but they represent the early stages of a profound new step in IAM technology.

A key factor in the ability to implement dynamic feedback control is the empowerment to actively manage the control parameters in the infrastructure components. An inherent distrust of automated control will hamper efforts to deploy truly adaptive infrastructures. This impediment is most prevalent in the network infrastructure, especially the wide-area network. Quality-of-service technologies (e.g., MPLS, DiffServ) hold some promise to this end, but explicit intervention of management software into the configuration parameters of routers is still a sensitive subject. The industry must overcome such anxiety if infrastructure organisms are to be realized. The basic technology exists. Cultural, political, and emotional roadblocks need to be transcended. Automation is often greeted with opposition from those who perceive the technology as a threat. Management feedback is inevitable and will be necessary to keep pace with more efficient infrastructure operations.

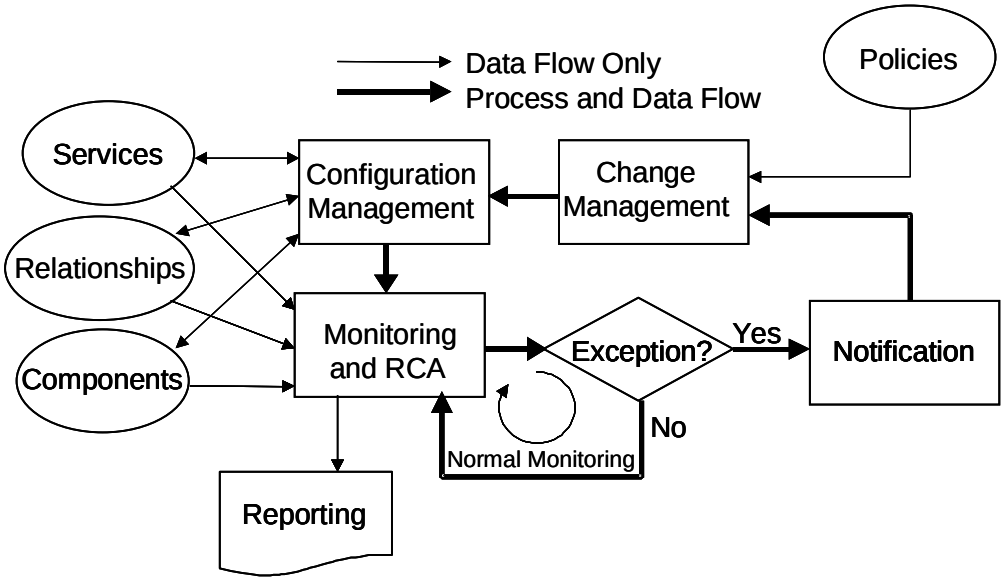
Automation pitfalls can be avoided with careful planning. Infrastructure service providers are finally offering services that can contribute to the progress toward organic infrastructures. By insulating enterprise network managers from the responsibility and dangers of automated network controls, many fears are alleviated. As service providers blend functions, such expanded offerings will be their differentiating value proposition. An important capability toward this end is dynamic provisioning. As the infrastructure determines a need for additional resources, the management system requests a surge in resources to fulfill the need. Early dynamic bandwidth provisioning is now appearing from carriers such as Yipes Communications and Broadwing. Ejasent offers a similar on-demand capability for server resources. Proprietary solutions within the service provider community are prominent, but commercial offerings (e.g., Syndesis) are beginning to address these management needs. A logical next step is to integrate business processes of enterprises and service providers. Lessons taken from XML-based electronic commerce will be adopted for this integration, with good progress through 2002. Strong integration will be an acceptable practice by 2002/03, and popular by 2004/05.

As the industry moves closer to this reality, new and enhanced services can be envisioned and IT organizations can direct more energy to business services. The trend toward managed infrastructure services and away from private infrastructures will accelerate. The task of managing the infrastructure will become easier, because more of the manual processes will be automated and more of the infrastructure will be in the form of services. Managing service providers will become an increasingly important business priority.

Bottom Line

A slow evolution of dynamic infrastructure mechanisms is now accelerating. Infrastructure behavior will possess basic characteristics and resemble biological organisms by 2004/05.

Figure 1 — Infrastructure Management Process (With Feedback)



(RCA — Root-Cause Analysis)

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