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Service Management in a Telecom Environment based on Active Network Technology

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To Christa, Ernst, Erika, Lucas, and Ramona

Abstract

Active networking, where network nodes perform customized processing of packets, is a rapidly expanding field of research. This thesis investigates the realization of service provisioning and service management in a telecom environment that is based on active networking technology, primarily with respect to customer-provider interactions. Compared to conventional networking technology, active networking concepts enable additional flexibility in supporting management tasks.

We define a management architecture for active networks that allows customers, on the one hand, to access and manage a network service in a provider's domain, and, on the other hand, to out-source a service and its management to a service provider, a capability that is not feasible in traditional networking environments. Our architecture has the properties of supporting (1) generic, i.e., service-independent, interfaces for service provisioning and management, and (2) customized service abstractions and control functions, according to a customer's requirements.

The key concept in this management architecture for active networks is the Virtual Active Network (VAN). A VAN can be seen as a thin (software) layer in an active networking environment, which creates a

generic service abstraction, offered by the provider to a customer. From the customer's point of view, a VAN represents an environment on which the customer can install, run and manage active network services, without further interaction with the provider. From the provider's perspective, the VAN serves as the entity for partitioning the provider's resources and isolating customers from one another in virtual environments.

Further the thesis investigates the realization of service management on a Virtual Active Network (VAN). The VAN concepts transforms a multi-party active networking situation into a single domain for a customer, where the customer can install, run and supervise network services.

We describe a service management toolkit, which facilitates designing and managing network services taking advantage of active networking technology for code reuse, code distribution, flexible event filtering, and programmable management information aggregation.

We describe how the architecture including the VAN concept, VAN management, and customer service management is realized on ANET, an active networking testbed that we have built at the Computer Engineering and Networks Laboratory (TIK) of the Swiss Federal Institute of Technology in Zurich (ETH). Further the architecture is validated by demonstrating some management scenarios. And we discuss the realization of the management architecture for active networks on high-performance active networking platforms.

Keywords

Management of Active Networks, Network Architecture, Service Provisioning, Service Management, Service and Network Monitoring, Event Handling, Virtual Networks.

Kurzfassung

Aktive Netze sind Kommunikationsnetzwerke, die es erlauben, kundenspezifische Verarbeitung von Netzwerkdaten (Paketen) auszuführen. Diese Dissertation basiert auf der Annahme, dass aktive Netzwerktechnologie zu einem Punkt reift, an dem sie kommerziell verwendet werden kann. Wir erforschen die Realisierung der Dienstbereitstellung und des Dienstmanagements in einer Telekommunikationsumgebung, die auf aktiver Netzwerktechnologie basiert. Wir betrachten dies hauptsächlich in Bezug auf die Kunde-Anbieterinteraktion. Verglichen mit herkömmlicher Netzwerktechnologien, unterstützt das aktive Netzwerkkonzept in weit grösserem Masse zusätzliche Flexibilität um Managementaufgaben zu realisieren.

Wir definieren eine aktive Netzwerkmanagementarchitektur, die es Kunden einerseits erlaubt, auf Dienste beim Anbieter zu zugreifen und die Dienste auch zu kontrollieren, anderseits aber auch Dienste an Dienstanbieter auszulagern. Unsere Architektur hat die Eigenschaft, dass sie dienstunabhängige Schnittstellen ermöglicht, um Dienstbereitstellung und Dienstmanagementaufgaben auszuführen. Des weiteren unterstützt sie kundenspezifische Dienstabstraktionen und kundenspezifische Kontrolle über die Dienste.

Das Schlüsselkonzept in unserer Managementarchitektur ist das virtuelle aktive Netzwerk (VAN). Ein VAN ist eine generische Dienstabstraktion, die ein Anbieter seinen Kunden offeriert. Der Kunde kann seine speziellen Dienste ins VAN installieren, dort ausführen und überwachen ohne mit dem Managementsystem des Anbieters weiter in Kontakt zu treten. Der VAN-Anbieter teilt seine Netzwerkinfrastruktur in verschiedene VANs, die voneinander isoliert sind und einen bestimmten Teil der Ressourcen zugeteilt bekommen.

Weiter betrachten wir das Dienstmanagement auf einem solchen VAN. Wir definieren Werkzeuge, welche den Design und die Implementation eines Dienstes und dessen Management vereinfachen. Dies kann durch die Wiederverwendung der Programme, flexible Eventfilter und Informationaggregation erreicht werden.

In dieser Dissertation wurde ein aktives Netzwerk (ANET) implementiert. Auf ANET wurde dann die aktive Netzwerkmanagementarchitektur implementiert, welche das VAN Management und das Dienstmanagement des Kunden beinhaltet. Des weiteren wird die Architektur durch Demonstrationen evaluiert. Wir beschreiben auch wie die Managementarchitektur auf einem schnellen aktiven Netzwerk realisiert werden kann.

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