CUSTOMER SERVICE MANAGEMENT: A MORE TRANSPARENT VIEW TO YOUR SUBSCRIBED SERVICES

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Abstract

The new era in telecommunication with it's evolving markets exposes all players to strong competition. Effective and efficient end-to-end service management is becoming a key factor for service providers and customers in today's globalized and heterogeneous world.
This paper proposes Customer Service Management (CSM) as a powerful instrument to enhance service management at the cutting edge of technology. CSM allows for the monitoring and controlling of service level agreements negotiated between providers and customers, and offers benefits for both parties. The requirements for a generic CSM service are described, and an architecture for a service-independent CSM platform that implements this service is proposed. The applicability of our approach is shown by means of a research project.

Keywords: Customer Service Management, Customer Network Management, Service Management, Customer/Provider Relationship, Service Level Agreements, Quality of Service

1 Introduction

The telecommunication sector has mainly been driven by the deregulation of PTT monopolies in many countries within the last decade. The emerging markets force service providers to think in terms of services, quality-of-service (QoS) parameters and service-level-agreements (SLA) when talking to customers rather then of network devices or end systems. Consequently, network and system management platforms have become an indispensable prerequisite for service provisioning, but, as a sole means, are no longer sufficient: The paradigm-shift towards service management forces the installation of service management facilities that allow for the monitoring and controlling of QoS parameters and SLAs.

This paper focuses on one important task in service management that we call "Customer Service Management" (CSM). It enables customers to monitor and control up-to-date, meaningful and adequate information about customer- and service-specific QoS parameters and offers a competitive advantage to providers. Section 2 describes the main problems associated with service management and outlines the state of the art. Section 3 defines the requirements and benefits of a CSM service. Section 4 presents an architecture for a generic, end-to-end CSM platform that implements this CSM service. To prove the applicability of our concepts, section 5 describes a prototype implementation of a CSM platform as part of a research project. Section 6 gives a summary and discusses open questions.

2 Problem Description

2.1 Critical Issues

The relationship between customer and provider can be seen from different viewpoints, depending on the focus (see Figure 1). From a **contractual** point of view, customer and provider negotiate about QoS parameters, which reflect the characteristics of the service. Based on these negotiations, a service-level-agreement (SLA) is signed, which defines definite rights, obligations and responsibilities for both parties. For the **provisioning** of the service, the provider offers the service to his customer, which can use the service by himself or, in turn, can set up a value-added-service on top of it. For **management** purposes, the provider uses some kind of network and system management facilities (such as management platforms, trouble ticket systems and various other tools) that are necessary for the operation, administration, management and provisioning of the service. The customer will use similar facilities in his environment for the same reasons.

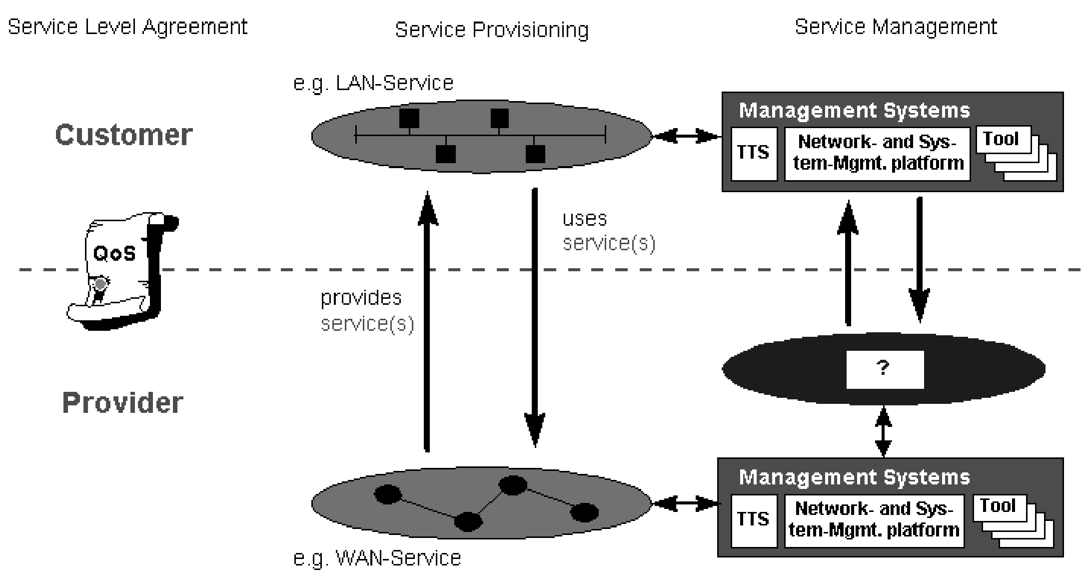

Figure 1: Problem Description

The major drawback in this scenario is, that no exchange of management information between customer and provider takes place. As such, customers cannot monitor or control the QoS parameters of their subscribed services; no integrated fault management can be established, and an automated configuration and change management is not feasible.

In multi-level service hierarchies, rather more problems are caused by this drawback, because all players in service hierarchies have to deal with the fact that they have to provide services according to certain SLAs to the higher level but cannot determine the QoS parameters from the lower level.

2.2 State of the Art

The problems identified above have been addressed by means of a Customer Network Management (CNM). The main emphasis of this approach lies on providing CNM information for special technologies (such as SMDS [SMDS91], Frame Relay [FR94] and ATM [M3Spec96]) and the integration of CNM functionality in existing management platforms.

This approach is not satisfactory, as the standards mentioned above are device-oriented and not service-oriented. The provided CNM-MIBs are composed of views on the technology specific device MIBs. This information is neither condensed nor aggregated and thus does not reflect the SLAs. The techniques used to model and access CNM-MIBs are usually based on the Internet Management Framework that is not suitable to deal with service management issues. Typically, the CNM approach allows monitoring functionality only.

The integration of CNM functionality in existing management platforms is a time-consuming task, as these platforms are targeting for device-oriented management information that is necessary for the operation, administration and maintenance of services and does not relate to SLAs. The information stored is for internal use and does not allow for different customer- and service-specific views. Besides this, most management platforms cannot handle an arbitrary number of users, connecting from remote sites using different management platforms. And even if they were, security policies simply prohibit that.

3 Customer Service Management Service (CSM Service)

The discussion in the previous section pointed out, that the CNM approach is not sufficient to address the critical issues. Therefore, we promote a service- and platform independent *Customer Service Management service* (CSM service) that enhances service management of providers towards their customers. Section 3.1 describes the requirements such a CSM service has to meet; the benefits for both, provider and customer are outlined in section 3.2.

3.1 Requirements

The CSM service has to be part of the provider's service management and has to offer functionality on all functional areas of management that seem reasonable for a given service:

Configuration and change management: This provides functionality to access service configuration details, the ability to change the configuration (and the associated QoS parameters) and the complete service ordering process, including (un)subscribing services and subservices.

Fault and performance management: This facilitates monitoring and controlling of QoS parameters and SLA violations, especially the automatic notification on problems (by the provider) and the ability to report detected problems (by the customer). In addition, it must offer the capability to access historical statistic data about the QoS parameters.

Accounting management: This includes access to all relevant accounting information about the subscribed services, for example used resources, the costs incurred thereby, the current pricing scheme and an electronic version of the invoice.

The information provided has to be meaningful, up-to-date and adequate. Thus it has to reflect the SLAs and the QoS parameter that have been negotiated. The information has to be useful especially in situations where problems and/or failures affect the quality of the service. In this case, the CSM service must help to detect the source of the problem disregarding organizational and management domains as well as areas of responsibilities. The information has to be presented by means of adequate visualization techniques, and it must be possible to integrate the information into the management platforms of the customer.

All information and functionality has to be provided by means of views that are freely configurable by the provider for each customer and each service. This ensures, that only relevant information in a suitable granularity is passed on, and appropriate action can be taken by the customer.

As Figure 2 depicts, the CSM service can be implemented by means of a dedicated, service-independent **CSM platform** that is run by the provider and acts as an intermediary between the provider's service management and the customer's management.

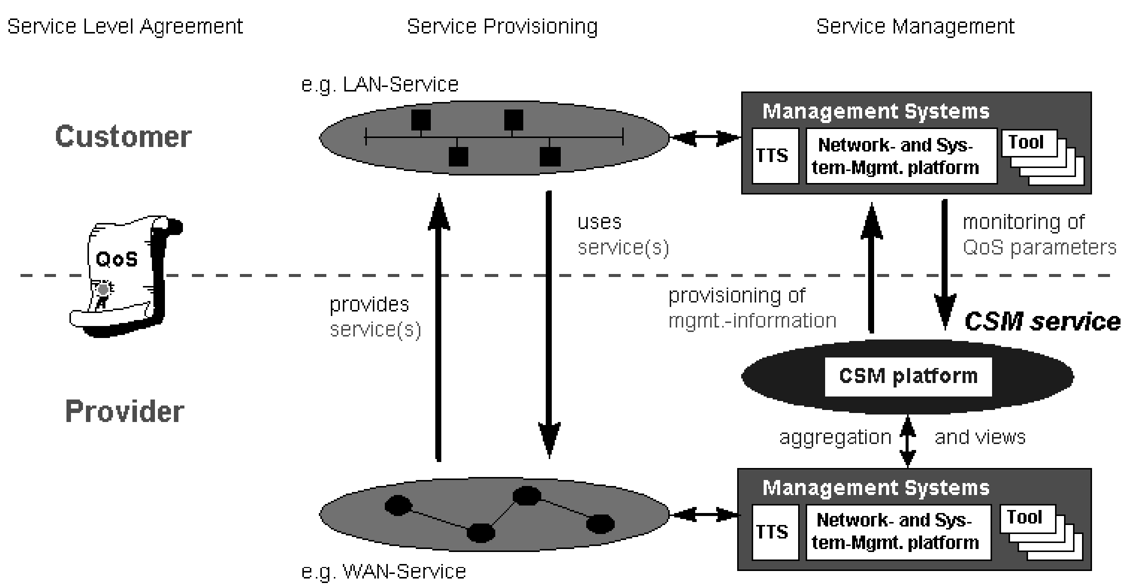

Figure 2: Integration of the CSM service

In comparison to the CNM approach, our CSM service allows for monitoring *and* controlling. The information provided consists of valuable, meaningful, condensed and customer-specific information that clearly reflects the SLAs, not network devices or end systems. The service-oriented approach allows for the applicability on arbitrary services as opposed to the CNM approach, which is technology-specific. The dedicated CSM platform sets up a secure and scalable environment for implementing this CSM service.

3.2 Benefits for the Provider

- **One face to the customer:** The CSM service offers one interface to all customers that have subscribed the service. It offers an efficient way to merge and distribute information amongst all customers on-the-fly. This improves response-times and results in better informed customers. The workload on the hotlines and support services is lowered, as many problems can be solved without consulting the provider.

- **Full control over the published information:** As the service is run by the provider, he can decide, which information to publish. In addition, he can freely configure customer-specific views on this information and provide the appropriate granularity of information for each customer. He can limit and control the actions to be taken by the customer.

- **Integration of workflow management:** Due to the clearly defined interfaces and SLAs, problem causes can be assigned to services and the corresponding provider. Responsibilities are clear and the related workflow management procedures (such as troubleshooting and escalation procedures) can be triggered automatically.

- **Service life-cycling:** The information collected and provided can be used to optimize resources for a given service. Statistics can be used for network and service planning purposes.

- **Low effort – high impact:** At least part of the information is necessary for the provider and has to be collected anyway. Implementing a CSM service that provides subsets of this information to customers costs comparably little resources. The impact is way higher: Increased customer satisfaction and strong bonds make long-term planning easier.

The CSM service is an additional feature of an existing service that clearly distinguishes the provider from his competitors without such a feature; CSM is a competitive advantage in deregulated markets with strong competition.

3.3 Benefits for the Customer

- **Single source of information:** All the information necessary for the customer is available on-the-fly by the CSM service. There is no need to check out the various WWW-servers, news groups, mailing-lists, hotlines etc., as it is common these days. Fault-localization gets simplified and less time-consuming; requests concerning a problem that is caused by the provider can be forwarded to the provider.

- **Value added information:** The CSM service delivers customer-specific, meaningful, adequate and up-to-date information about the subscribed service. It renders the customer's ambitions to collect information on the QoS parameters obsolete, as these are available by the provider. The provided information is an indispensable prerequisite to set up value added services on top of an existing service.

- **Increased service transparency:** For the customer, the service becomes more transparent and facilitates end-to-end service management, as the provided information can be integrated into his management facilities.

- **"Service-on-demand":** Customers can configure the subscribed service in a provider-controlled, restricted way. This improves the flexibility of service usage according to the current needs.

For the customer, the CSM service offers a wide range of information that is necessary but difficult or impossible to collect. It facilitates value-added-services and increases the transparency of the subscribed service.

4 Architecture of a Generic CSM Platform

This section focuses on the architecture of a generic CSM platform that implements the CSM service and meets the requirements as defined in the previous section. Section 4.1 outlines requirements that have to be met by the generic CSM platform. Section 4.2 describes, how the necessary and relevant CSM information can be acquired; section 4.3 identifies the required CSM platform functionality.

4.1 Requirements for a CSM Platform

The CSM platform has to deal with all kinds of heterogeneity: The customers and providers are distributed geographically throughout the country or even worldwide. They belong to different domains and implement different policies towards management, security, accounting and so on. At the customer's site, heterogeneous environments with all types of hardware, operating systems, communication protocols and software (especially management platforms) can be found. The CSM platform must be able to support arbitrary services and must be applicable on every level of the service hierarchy. Huge amounts of customers and even more users call for efficient administration.

4.2 CSM Information

There are two ways to acquire CSM information. The *bottom-up* approach, as it is realized by CNM, acquires management information mainly from existing device-MIBs. The *top-down* approach suggests the use of SLAs as a source of relevant CSM information. Appropriate characteristics have to be found, which reflect the service.

The problem with these two approaches lies in the fact, that the bottom-up approach provides huge amounts of data that do not reflect the SLAs, whereas the top-down approach asks for characteristics that are often difficult to define and measure. To close the gap between these two approaches, we propose to map the characteristics onto the available information base, such as:

- **Device-MIBs:** The MIBs contain raw management information about devices, protocols and local applications.

- **Management platforms:** These platforms contain huge amounts of data that are a valuable source of information (e.g. topology, event reporting, status, threshold and performance monitoring, …).
- **Help Desk:** E.g. trouble ticket systems that are used to support configuration, change and fault management.
- **Various databases:** This includes the use of directory services (e.g. X.500, NIS) to collect necessary information about the customers such as contract number, contact details, bank details and so on.

By means of this technique it is possible to provide the meaningful CSM information that reflects the SLAs for the customer. The definition of these characteristics and the mapping onto existing information bases has to be done individually for each service. This is illustrated by the following simplified example:

The customer of an IP connectivity service is not interested in the In/Out-Octets of the router interface he is linked up to his provider; he is interested in, for example, the IP utilization, which can be calculated as follows[1]: IP utilization = IP throughput[MBit/s] / IP bandwidth [MBit/s] * 100 [%].

Once the relevant CSM information has been identified, it has to be described in an implementation-independent way. This is necessary to allow for the integration of CSM information into management platforms. The specification of CSM information leads to a generic CSM-MIB. The description of this CSM-MIB cannot be based on the "structure of management information" (SMI) as it is defined by the IETF ([RFC1155]), because the managed objects can only be modeled by means of values and tables. Instead, more powerful, object-oriented techniques (such as defined by the information models of CMIS/CMIP or CORBA) have to be used. The description and the contents of this generic CSM-MIB is subject to further study.

4.3 Platform Functionality

The CSM platform has to offer functionality that is usually found within management platforms ([HeAb95]). Besides this, it has to offer additional functionality. The infrastructure (section 4.3.1) contains all platform functionality that is not directly related to a service whereas the application logic (4.3.2) models the service-specific details of arbitrary services.

4.3.1 Infrastructure

- **Gateways:** As the CSM platform does not acquire the information by itself, it has to get the information from the information bases described above. It's the task of the Gateways to link up all these information bases as well as providing an interface to access the information for integration in the customer's management platforms.
- **Security issues:** Authentification, authorization and encryption has to be enforced to guarantee the security of the CSM service and the privacy of the provided information.

[1]This is a simplified formula, as it does not consider IP overhead.

- **Implementation of a generic view-concept:** The view-concept allows to provide an individual view of the available CSM information to each customer and user.
- **Administration of the CSM platform:** Flexible administration of all services, customers, users, views and the CSM platform is an important feature, as this information is highly dynamic and changes frequently.

4.3.2 Service-specific Platform Logic

- **Calculation of the meaningful information:** This functionality implements the service-specific mapping from the characteristics of a service to the information base.
- **Access to the provided information:** The service-related information must be presented by means of a flexible frontend that allows for the interaction with the CSM platform.

5 Research Project: CSM for the B-WiN

The architecture described in the previous section has been implemented as part of a two years research project at the Leibniz Supercomputing Center (LRZ). The project is supervised by the German Research Network Organization ("DFN-Verein") which runs a nationwide network that connects the german universities and research organizations to the worldwide internet. The project is funded by the Federal Ministry for Education, Science, Research and Technology.

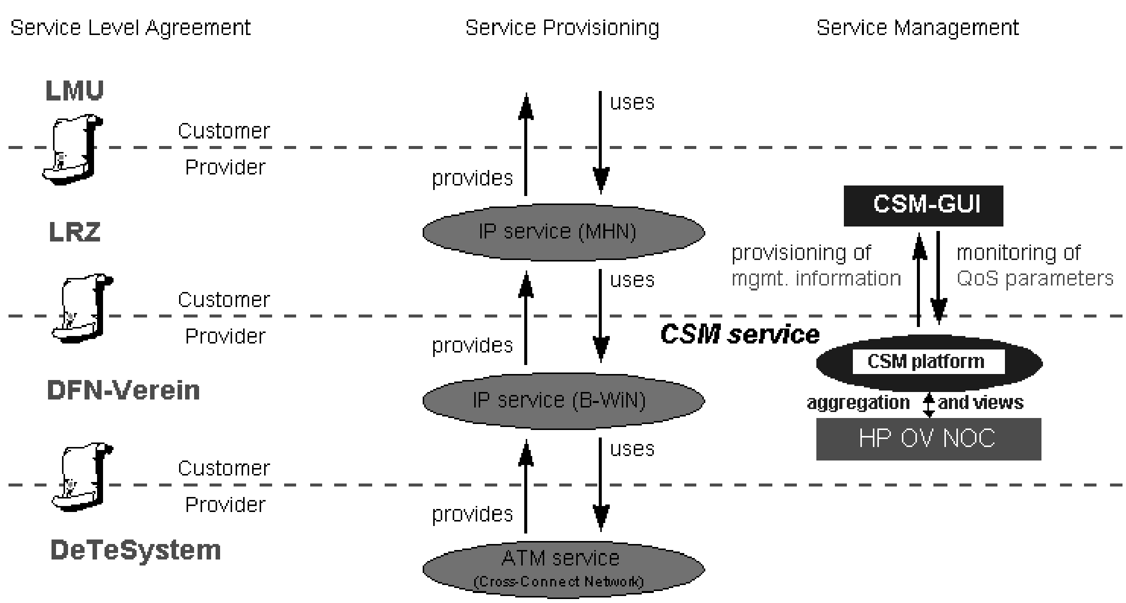

Figure 3: Service hierarchy within the Research Project

As depicted in Figure 3, the DFN-Verein runs the Broadband-WiN (B-WiN), which is, technically speaking, a virtual private network based on the ATM cross connect network of the Deutsche

Telekom AG. The DFN-Verein offers an IP connectivity service to all german universities and research organizations. The LRZ, for example, uses this IP service to connect the Munich University Network (MHN) to the internet.

In this section, the software architecture of a generic CSM platform based on state of the art methods and techniques is presented. As depicted at the right side of Figure 3, the architecture is instantiated for one particular service, the IP connectivity service.

5.1 Software Architecture

To meet the requirements defined in the previous section, the client/server paradigm was applied and an object-oriented design method was used. The CSM platform was modeled in OMT using the CASE tool StP from Aonix. The distribution and heterogeneity problems were addressed by means of the CORBA communication infrastructure. As depicted in Figure 4, the ORB dominates the CSM platform and connects an arbitrary number of CSM clients to the CSM server.

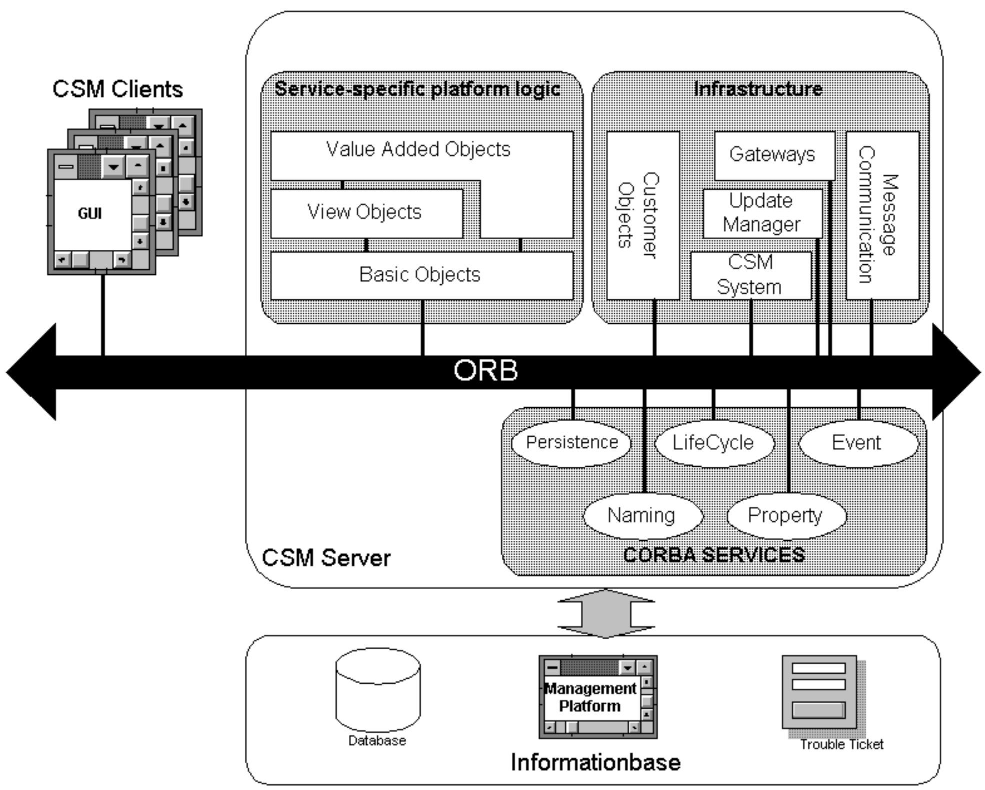

Figure 4: Architecture of a generic CSM platform

The **CSM client** visualizes the CSM information by means of a Java applet that is downloaded from the Web and runs within a common WWW browser environment. This technique provides a high degree of platform independence and renders the software distribution problem obsolete.

The **CSM server** is implemented in C++ for performance reasons and runs on a dedicated machine. It implements the necessary CORBA services and the CSM application logic as defined in the previous section: The **infrastructure** contains, amongst other, the `Customer Objects` (which model the customers and their privileges) and the `Gateways` (which link up the different kinds of information bases like management platforms, trouble ticket systems and an internal databases). The **service-specific platform logic** consists of `Basic Objects` (that reflect the resources of the modeled service), `View Objects` (that allow a dynamic and flexible aggregation of `Basic Objects` in views) and `Value Added Objects` (which condense and aggregate the information stored in the `Basic Objects`).

5.2 Implementation

In the first phase of the research project, a prototype CSM platform had to be installed that provides relevant CSM information on the IP connectivity service. The implementation so far provides the following core functionality:

The B-WiN topology is visualized by means of hierarchically organized maps. In each map, state information concerning components and connections is displayed. These information reflect the B-WiN as it is seen by the network operating center (NOC). On each connection, a variety of statistics are available. So far, the configured bandwidth [MBit/s], throughput [MBit/s] and utilization [%] are supported. All information is updated every five minutes.

A history functionality provides overviews on state information and statistics in configurable granularity like daily, weekly and monthly graphs. This history information facilitates the optimization of network resources and network planning for the customer.

The CSM client provides a facility to enter fault messages by customers as well as the provider. These fault messages are propagated and displayed within the CSM client. Furthermore, a graphical frontend to the trouble ticket system run by the NOC is integrated in the CSM client.

All information is visualized by means of customer-specific views that display only information that is relevant for the corresponding customer. These views are based on authorization schemes and access profiles that are freely configurable by the CSM administrator. Some more administrative functionality allows for the administration of customers, users and services.

The prototype has been deployed in November 1997. The number of customers that have access to the CSM platform has grown to 70, with a total of approximately 200 users. The CSM platform will be extended to provide appropriate CSM accounting information on the IP connectivity service; furthermore, a CSM service for an ATM-PVC service has been designed and will be integrated into the CSM platform.

6 Conclusions and Further Work

This paper describes the idea of a **Customer Service Management service** (CSM service), which offers a competitive advantage to providers and enables customers to monitor and control up-to-date, meaningful and adequate information about customer- and service-specific QoS parameters. It presents the architecture for a generic CSM platform that implements this CSM service. A prototype implementation as part of a research project proves the applicability of our concepts.

The implementation will be extended to provide CSM information on several more services that are provided by the B-WiN, e.g. ATM-PVC service and M-Bone service.

The research activities will be focused mainly on the mapping techniques (used to aggregate characteristics out of raw data) mentioned above, the specification of a generic CSM-MIB and the definition and integration of workflows typically found in these multi-level service hierarchies.

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