Reconfigurability as a Key for new Network Services

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Introduction

In the future the complexity to build, to configure and to manage wireless access networks will increase due to the rising heterogeneity of network elements and technologies as well as due to the rising amount of network services. Future access networks will contain network elements supporting different types of radio technologies like WLAN, WIMAX, WIBRO, DVB, UMTS and GSM. Such heterogeneous network elements will require enormous operating expense for network connection, discovery, integration, configuration, monitoring, failure discovery, failure recovery as well as adaptation of the network to environmental changes.
Today's wireless access networks are built, monitored and managed through one administrative entity. Moreover often the administrative entity also develops and provides several network services (classical operator). Due to the high CAPEX of the classical wireless access networks they can only be economically successful if they can be used without modifications over a long time. Therefore it is difficult to integrate new services for the end users which thwarts the development of these services and thus restricts the maximum revenue for the network operators.
To overcome these restrictions we propose a new approach, which allows to distribute the operations performed by the former operator between different operation entities. Distribution of responsibilities through several entities (Operator, Service Provider) is very well known from the Internet and should be reproducible in wireless access networks. One key feature which enables the split into several operational entities is that the wireless access networks should be autonomic reconfigurable.
Reconfigurable networks are adaptable from layer 3 up to layer 8 of ISO/OSI model. Automations of several management processes could reduce the complexity and the OPEX of network management as well as it increases the flexibility in service provisioning.

The three provider approach

The proposed approach distributes the operations of wireless access networks between three operational entities, namely *Infrastructure Provider*, *Management Provider* and *Service Provider*.
The Providers could be economically, but not technically independent from each other.

Infrastructure Provider
The Infrastructure Provider is responsible for the physical networks of an autonomic reconfigurable network. He offers transport services to Management Providers. The reasons to build new infrastructure could be based on political or economical issues. A political reason could be to develop the infrastructure of a region as an instrument of business development.

Management Provider
The Management Provider manages the network in order to provide transport services and other services to the Service Providers. Their virtual network may consist of the infrastructure of one or more Infrastructure Providers. The different physical networks can be easily integrated, because of the autonomic re-configurability of the infrastructure. It allows complex reconfiguration processes ruled by abstract management policies. Management Providers offer management services beginning at a simple transport connection, up to complex network management services like managing and classifying data flows or even security, mobility and basic accounting services. They map services of Service Providers to network resources of Infrastructure Providers and distribute service functions at determined network resources of contracted Infrastructure Providers. A Management Provider is interested in an optimized mapping and distribution of service functions in order to minimize the resources consumption he has to pay for. Management Providers could be paid for the amount of traffic passing its virtual / logical network or rather for providing a virtual network equipped with customized functions.

Service Provider
Service Providers offer services at application level to the end users, as voice services, streaming or gaming. So they will develop convenient application services to gain advantages in respect to its competitors. To be able to provide application services, Service Providers have to make contracts with several Management Providers to lease or buy the resources they need.

Business Process

The following section describes one of the possible business processes to integrate new network services into a reconfigurable infrastructure. It explains the technical and economical coupling between the different providers.
A Service Provider has developed new application services. In the next step he looks for a network which is sufficient for its services. Therefore he contacts several Management Providers in order to find the most suitable transport service for its application. One or more Management Providers may decide to reconfigure their network so that they are able to fulfil the requirements of the new service. If the physical transport capabilities of the infrastructure are not sufficient any more, the Management Provider could decide to extend his resources by integrating new infrastructure. Therefore, the Management Provider leases infrastructure from one or more Infrastructure Providers and integrates it into his own managed network. Now service integration should be possible. An reoptimization of the mapping between service functions of application services and network elements of the managed infrastructure could be necessary. After the offline optimization, the network will be reconfigured automatically by placing the network functionalities to specific network elements. Now, the new services are integrated and they can be offered to the end users.

Conclusion

The break of the former one provider network into a relation of three providers, leads to enormous economical and technical benefits in providing services through wireless access networks. The proposed approach distributes the network operations between Infrastructure Providers, Management Providers and Service Providers. It replaces the today's fixed connections between infrastructure of wireless access networks and services by flexible, loosely coupled service relations. Management Providers can lease infrastructure from Infrastructure Providers, as much as he need for service provisioning. Or an Infrastructure Provider has the ability to change between Management Providers to get better or other services. Thus, the proposed approach could encourage the business competition, relax the complexity of network operations and could lead to an acceleration of the development of new services.
To realize the described approach it is necessary to strengthen the research in the area of autonomic reconfigurable access networks. In the presentation we will define which reconfiguration skills are necessary and what kinds of research issues are arising from them. Furthermore, we will provide a detailed scenario to show how this approach can be used to adapt the service offer of a mobile network to the continuously changing needs of a business park.