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Business Implications of Composition Framework in Ambient Networks

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This paper presents initial findings on how Ambient Networks technology will enable new ways to establish and manage access and service provisioning from a business perspective. A concept called network composition, developed in phase 1 of the Ambient Networks project provides the basic framework for ambient networking meaning that "any" user will be able to connect to "any" network implying that users have readiness to use services from anywhere as long as a service is available. This service availability is one challenge from business perspective. The paper focuses on the composition concept as a "tool" for making business, including how to dynamically establish and maintain business relations and how to handle related negotiations and transactions made "on the fly," and providing services for end users according their preferences "everywhere." The analysis is focused on five different aspects of composition; i) network advertising, ii) selection mechanisms and criteria, iii) negotiations on terms and conditions, iv) dynamic roaming and v) subscription provisioning. The methodology is based on the Business Blueprint Method and applied to a number of case studies.

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This paper presents initial findings on how Ambient Networks technology will enable new ways to establish and manage access and service provisioning from a business perspective. A concept called network composition, developed in phase 1 of the Ambient Networks project provides the basic framework for ambient networking meaning that "any" user will be able to connect to "any" network implying that users have readiness to use services from anywhere as long as a service is available. This service availability is one challenge from business perspective.

The paper focuses on the composition concept as a "tool" for making business, including how to dynamically establish and maintain business relations and how to handle related negotiations and transactions made "on the fly", and providing services for end users according their preferences "everywhere". The analysis is focused on five different aspects of composition; i) network advertising, ii) selection mechanisms and criteria, iii) negotiations on terms and conditions, iv) dynamic roaming and v) subscription provisioning. The methodology is based on the Business Blueprint Method and applied to a number of case studies.

Keywords: Ambient Networks, Network Composition, Business relations and roles, Network advertising, Network and service discovery and selection, Selection criteria, Composition Agreements, Dynamic roaming negotiations, Security, Trust

1   Introduction

In the Ambient Networks vision "any" user will be able to connect to "any" network. This will involve added dynamics in the relation between networks that will also challenge traditional "one operator – one subscriber" and "all accesses – one subscriber" solutions, implying both new forms of network cooperation as well as new types of cooperation between actors in the market. The Ambient Networks (AN) project aims to achieve this functionality in a technically simple manner, in order to increase the chances of its widespread adoption [1] [2]. The AN Project provides a framework for network cooperation, which we call *composition* [3]. The objective of composition is to provide a unified framework over which dynamic cooperation between heterogeneous network providers, a multitude of service providers, and 'third parties' such as clearing houses and aggregators is established. Technical and commercial cooperation is enabled using Composition Agreement (CA).

The paper focuses on the composition concept as a "tool" for making and supporting business on a "micro level". I.e. what are possible consequences for users and providers of AN technology when it comes to dynamic establishment and management of business relations in relation with underlying dynamic and heterogeneous network infrastructure and how to handle related offers, negotiations and transactions made "on the fly".

The paper is organised as follows: Chapter 2 introduces Ambient Networks and Network composition and chapter 3 describes the used methodology including the Business BluePrint Method (BBM), listing of case studies and common starting point for all case studies. In chapter 4 the case studies are analyzed using BBM with focus on value networks and what each business role can offer and will gain. In the concluding chapter 5 relations between roles are summarised.

2 Ambient Networks and the composition process

Network composition is a central theme in the Ambient Networks project. Composition describes a dynamic, uniform framework that allows heterogeneous networks to work together and to possibly form larger networks. One of the most relevant aspects is the heterogeneity of access technologies and the multitude of providers. Today's paradigm in which users do not have a large number of accesses to select from will not longer be valid in the near-future communication scenarios [4] [5].

Many different networks may be available, and the end user would have the freedom to select one or more of the alternatives. This implies another aspect of composition; i.e. access to networks where the user (or the user's home operator) may not have any previous agreement or relation with the operator of the network in mind and therefore an agreement needs to be established "on the fly" before the user is able to connect; this is called dynamic roaming. The basic purpose of network composition is to enable networks to cooperate automatically and the composition framework will support a wide range of different types of co-operation. In addition to dynamic roaming, the composition process also includes both configurations of Personal Area Networks as well as joint resource control of operator networks.

Roaming agreements between visited and home networks and cooperative resource control are two forms of cooperation between networks that is supported by the composition framework. The same is true for the attachment of a user device to a network, see figure 1 with an example illustrating all three kinds of composition.
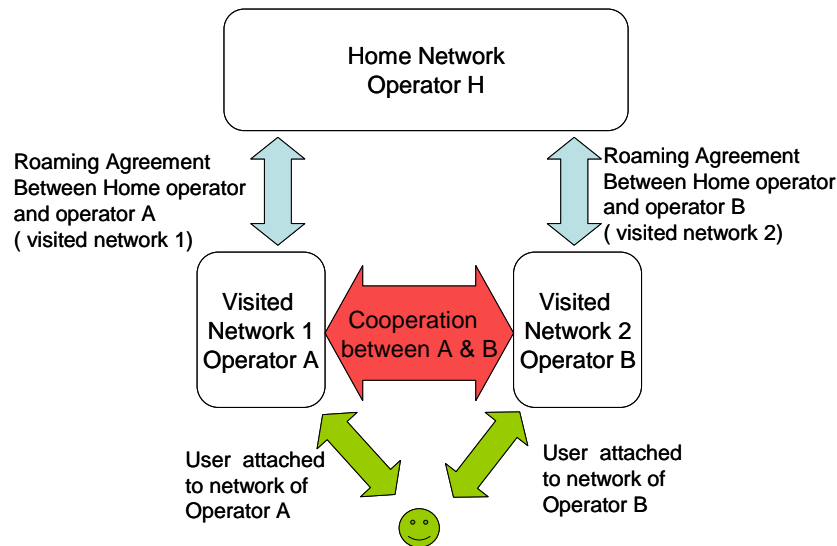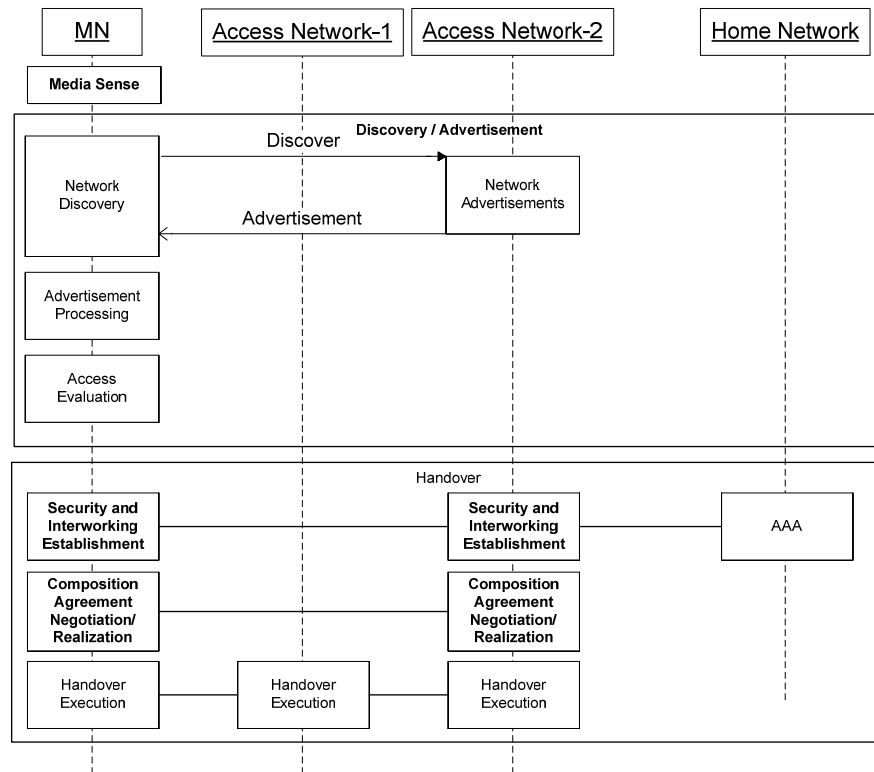

Figure 1: Example with Inter-operator handover requiring composition, the arrows indicates different forms of composition

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The composition process consists of the following phases; Media Sense, Discovery & Advertisement, Security and Internetworking Establishment, CA Negotiation and CA Realization. These phases are not necessarily passed in a one-way fashion, e.g. after establishing a security association, more services can be advertised which are only available under certain degree of trusted. Figure 2 illustrates the composition process by showing an example of the sequence of actions that are taken for an inter-operator handover.

Figure 2: Example of composition with sequence of actions for an Inter-operator handover

The paper will focus on five business aspects of composition that relate to the composition phases as follows:

- o *Network advertising* requires a successful Media sense phase to provide a media over which advertisement is done and it is part of Discovery / Advertisement phase.
- o *Selection mechanisms and criteria* occur during Discovery / Advertisement phase.
- o *Negotiations on terms and conditions* represents Composition Agreement Negotiation phase.
- o *Dynamic roaming* is an example "application" where a new roaming agreement is dynamically created using the Composition framework between two operators.
- o *Subscription provisioning* relates to most of these phases; 1) access subscription provisioning may require the establishment of a new roaming agreement and may also affect on what information an access network may advertise and 2) service subscription provisioning may affect on what information an access network may advertise and it may require a service subscription related configuration to be agreed during Composition Agreement Negotiation phase and to be set up during Composition Agreement Realization phase.

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3   Methodology and analysis approach

3.1   *The Business Blueprint Method*

To evaluate the feasibility of the technical functionality and business models we will employ a framework developed in Casal [6] where the business model is divided into four different perspectives:

1. *Value proposition*, which describes the value, often in terms of a service offering, that the value network offers to a specific group of users.
2. *Value network* that is a description of the configuration of actors, and the role each actor plays, needed to deliver the particular service offering. In particular, the value network aims to how the network creates value for end-users, but in this paper we also will look into what relations between roles and what is delivered to whom.
3. *Functional architecture*, describing the fundamental organization of the technical system and the technical architecture by the firms in the value network to deliver the service offering. In our case we will focus on the functionality provided by the composition framework, i.e. advertising, negotiations etc.
4. *Financial models*, which describes how the value network intends to capture monetary value from a particular service offering and how risks, investments and revenues are distributed among the different actors of a value network.

3.2   *Analysis scope and case studies*

Our main objective is to illustrate how the composition framework and the AN interfaces will enable new ways to communicate between different business entities and how this will provide opportunities for new and existing market players to make business in new ways.

Hence, we will focus on how different set of roles can interact in different ways in order to form different value networks. The functional architecture and the value proposition of composition will be discussed in general terms but for the analysis of value networks and the financial model (the revenue model part) we will present four case studies addressing different aspects of composition:

- Dynamic roaming case where operators of home and visited networks establish roaming agreement on the fly initiated by access advertisements broadcasted by visited networks.
- A case with a Service broker providing personalized service bundles for travelling people, which requires a wide range of agreements with service providers and local network providers.
- A case with provisioning of Value Added Services (VAS) in co-operation with network providers (controlling the delivery channel) and ID & payment providers (in charge of trust management and billing)
- Case where the advertising of access and service offers is made with directories that can be accessed by existing connectivity and possibly supported by brokers acting on behalf of users.

3.3   *Starting point for all case studies*

In order to analyze the business implications of advertising & discovery and evaluation & selection we need to consider

- WHO is advertising WHAT (the offer) on behalf of WHOM
- WHO is advertising WHAT to WHOM

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A network operator can advertise own access offers OR (service) offers on behalf of other providers, hence we have to distinguish between the distributor of the offer and the "offering party" i.e. the party providing the offer.

We also have to consider cases where offers are NOT distributed by broadcasted messages or by targeted messages sent out as response to service requests by users. In early stages of migration towards full AN functionality (i.e. when air interface standards and/or terminals do not support transmission and reception of advertisement messages) offers have to be requested and distributed using established connectivity. In figure 3, a situation is depicted where a user is requesting offers from a directory with service and access offers. In this case the party managing the directory of offers is the "distributor of offer".

When a network operator advertises its own access offers this will trigger a negotiation of agreement between the advertising network operator and the end user or the home operator of the user. When the network operator advertises on behalf of other providers the "offering party" could ether be a value added service providers or another network operator offering connectivity to own customers (subscribers) using a "roaming partner". In both these cases the end-user will negotiate and establish agreements with the "offering party"
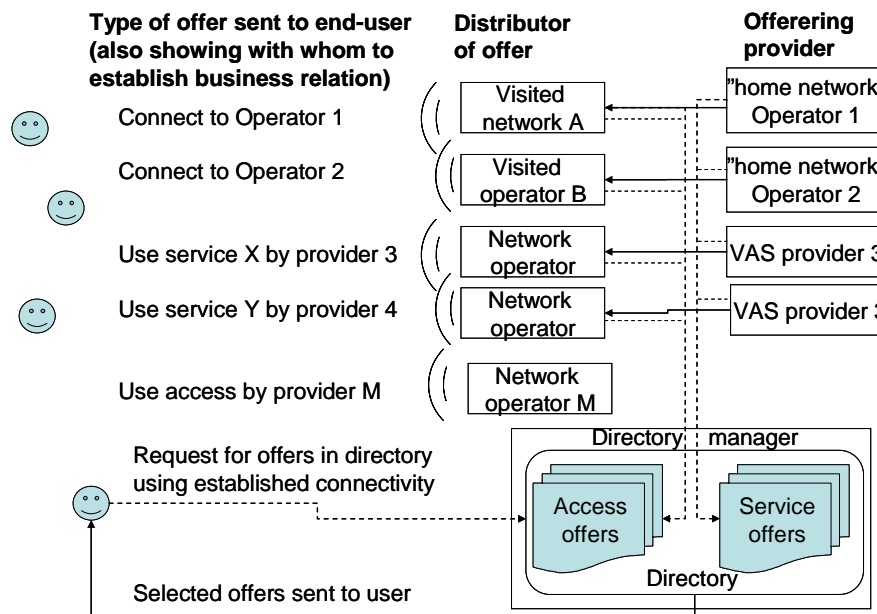

Figure 3: Map of actors involved in advertising and example of type of offers

Additionally, there are also other affecting factors like user's identity and device capabilities, existing relationships between content/service providers and the advertising party. User's identity may affect on WHAT can be advertised; i.e. some information might be common for everyone but there could be also some subscription specific information that should not be revealed to everyone. Device capabilities may affect on HOW this advertisement should be carried out; i.e. what mechanism(s) should be used. Existing relationships of an advertising party affect on what information could be advertised, since these relationships represents potentially reachable/available service/content providers for a user. Negotiations on terms and conditions make it possible to establish new relationships dynamically over which new information can be advertised. Subscription provisioning is involved when a relationship between two parties is subscription based.

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4   Analysis

4.1   *Dynamic roaming*

Because there is today a tremendous increase in the number of access networks available to users the kind of scenarios that the AN architecture ultimately aims to address involves on one hand a very large number of market players and on the other end customers who typically consume network access and value added services with a multitude of providers. Roaming agreements make a wireless customer able to use services provided by a visited network with which it has no direct relationship when it is outside of its home network coverage area. Financially, such roaming agreements are beneficial to both the visited and home network: the visited network earns money for use of its network resources, while the home network earns money for use of its identification and billing infrastructure. Functionally, the customer benefits from an increased service coverage area.

In current wireless wide area networks (e.g. GSM), roaming agreements are established out-of-band in a non real-time fashion: A costly and lengthy administrative procedure involving human intervention is required a priori to any customer communication. Such *static* roaming agreements are usually in place between any two GSM operators from different countries. Because the number of providers expected in this scenario is very large, it is likely that the customer's home network operator will not have pre-established roaming agreements with every visited network provider the customer may attach to. There is hence a need to establish roaming agreements in a dynamic fashion. Dynamic roaming agreements allows secure establishment of a bi-lateral roaming agreement between two operators via a chain of trust. This chain of trust involves credential issuers operated by industrial or governmental organisations which act as trusted third parties (TTPs) to provide a means to establish trust between two operators with no previous direct security relationship. A federation of credential issuers provides a mechanism to bridge trust relationships between operators registered with different industrial or governmental organisations. A credential issued by a credential issuer provides information regarding a given operator which is used by another operator to decide whether or not it wants to establish a new roaming agreement. The credential also contains keying material used to secure the agreement.
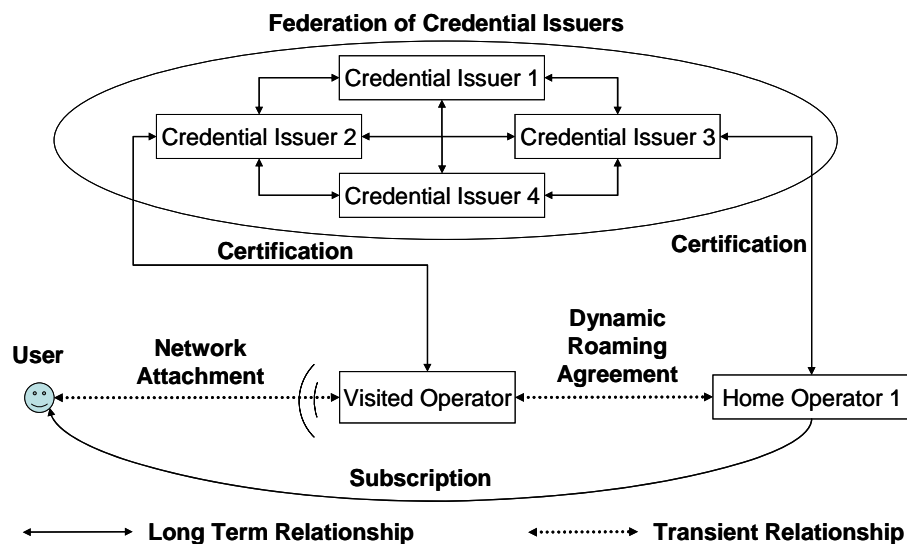

Figure 4: Relationships for actors involved in Dynamic roaming

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Value proposition and Financial models:

The customer benefits from an increased coverage area. Consequently it is likely that the customer will consume more services and will hence pay more to its operator.

The visited operator benefits from an increased user base: its own customers plus those of operator that do not have complete coverage. That generates increased revenue.

The home operator benefits from additional revenue generated by its own customers which are able to access services while connected to a different network provider.

The credential issuer benefits from increased revenue generated by the operators via two possible ways: a government issuer might be financed via taxation of telecommunications revenue, while an industrial partnership would be financed by operators.

Value network and Functional architecture:

The customer consumes network access and value added services offered by network and service providers.

The visited operator offers to a customer of a different operator network access allowing to access services offered by different provides.

The home operator offers to its customer attached to other network providers

- Access to their identification and billing infrastructure.
- Continuity of services they are subscribed to.

The credential issuer offers operators and credential issuers a mean to establish a dynamic roaming agreements between operators via the agreements it has with other credential issuers and operators.

4.2 Case with Service broker for traveling business people

In this case, the service broker targets its services for business person travelling frequently in Europe. To be able to provide easy to use service, the service broker has negotiated agreements with local access providers in biggest European airports. These access provides could be "pure" hotspot access providers or they could be operators. This makes it possible to provide adequate service coverage, which is one crucial feature of these services, since up-to-date information is important for these customers. From service perspective, the provided content is tailored for various business needs and it is provided by service providers; some of them could be considerable small but specialized to produce high quality and up-to-date content in its area. From access perspective, the service broker has agreements with access/hotspot providers of biggest European airports. When a customer attaches to such access/hotspot, the service broker could take care of identification and billing implying that it also provides a compensation for local access/hotspot providers.

Figure 5 represents an example of this case where users have subscribed to services from the service broker, which has three different service providers to produce the content for its services. The service broker has agreements with access providers offering a network access for the subscribers to access their services. The service broker is able to switch service providers according to content pricing and quality and content delivery reliability without that those users are able to see this. This makes it possible for the service broker to keep its services competitive and to maintain its quality, which is one way to differ in competitive market segment.

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Network/Service Environment
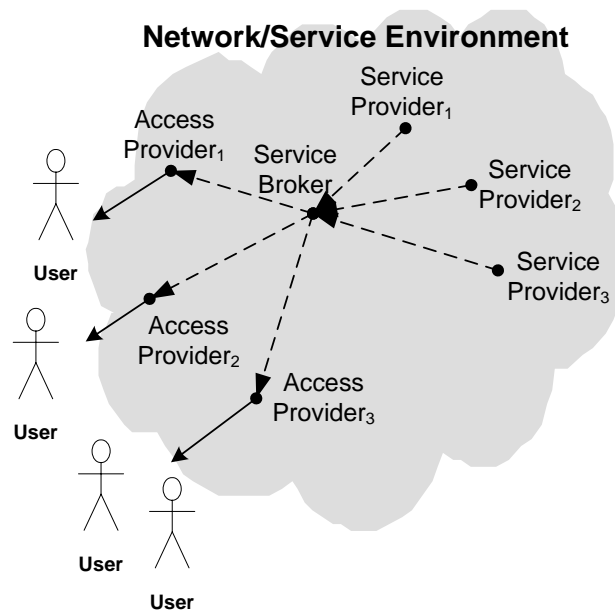
Figure 5: Service broker and relations with other roles

The table below summarizes different business roles in this example and their main functions.

Business Role	Gains	Offers
User	*Better service coverage, easy access to services, easy use of different accesses, high-quality tailored services*	*Payment*
(Local) access provider	*Increased user base resulting increasing revenue*	*Access services*
Service broker	*Extended service coverage, revenues*	*Subscription management, billing service for service providers, authentication & authorization service for local access providers, compensation for local access and service providers*
Service provider	*Larger increased customer base resulting in increased revenue, external billing service provided by the service broker*	*High-quality up-to-date content*

Value proposition and Financial models:

The customer benefits from an increased service coverage area and gets better value for the money, since only the services (s)he is using are paid. These services are easy to use and do not need a new payment every time (s)he uses them from a new airport.

The local access provider benefit from an increased user base and an enhanced end user experience is a positive (indirect) advertisement in forms of positive images for a local access provider. The increased customer base generates increased revenue.

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The service broker benefits from additional revenue generated by its own customers who are able to access services via different local access providers according to agreements between the service broker and providers.

The service providers benefits from additional revenue generated by the customers of the service broker. A service provider might not have abilities/resources to negotiate directly with access providers and it might not have sufficient infrastructure to take care of billing and subscription management that are taken care of by the service broker.

Value network and Functional architecture:

The customer consumes network access and value added services offered by local access providers, the service broker and service providers.

The local access provider offers to a customer a network access allowing using services provided by the service broker.

The service broker offers to its customer's use of its identification and billing infrastructure according to their subscription and continuity of services they are subscribed to.

4.3   Case with Value Added Services

To get Value Added Services (VAS) one can reuse the Home network / Service broker for subscription provision. In this case the VAS would be arranged in a similar way as in the case described above. In this case an alternative way to provide subscription is introduced. The provider of VAS could offer services to complement the normal services that the user receives through the normal subscription relationship. The user can have subscription through a home network or broker such that the billing and related accounting is located at the single location. The VAS case could be different as the service provision is not arranged through the normal subscription, but the service is additional and arranged separately, thus the relationship is direct between the VAS provider and the user. The use of VAS services could imply that several individual VAS subscriptions are required, one subscription for each VAS.

The lack of VAS handling capability at the home network or service broker means that the goal to have easy of service use is challenging with the use of many separate VAS subscriptions. The recommended way to hide the multiple subscriptions from the customer is to be able to bind several VAS subscriptions to the ordinary user subscription. The binding indicates a need for agreement between subscriptions on an individual subscriber level, this in contrast to service broker agreements based on service aggregation level. One possible character of VAS service is that it is available at visited networks with selected capability to support it, e.g. such service that the own subscription provider will / can not offer or directly handle. Thus there will be multitude of VAS service depending on capability of visited access networks and the dynamic access option require that the new VAS need to be able to form dynamic agreements with the users subscription for easy service use. Also the capability to support VAS in an access network depends on the relationship between the access provider and the VAS provider. This would imply an agreement between the AP and VAS provider is needed too for VAS advertisement purposes.

The subscription to VAS would be between customer and VAS provider, the binding of the VAS subscription to the normal Home network or Service broker subscription would require a dynamic composition agreement to facilitate simple use of service handling through a single subscription channel. The VAS provider is managing service subscription, but in close cooperation with customer care functionality of the normal subscription provider.

The table below summarizes different business roles in this example and their main functions.

Business Role	Gains	Offers
User	*Improved and extended service experience*	*Payment*
Visited access provider	*Increased user and service base resulting in increasing revenue*	*Access services*
Home network / Service broker	*Additional services, revenue and customer loyalty*	*Subscription management, billing service for VAS service providers, AAA services for local access providers, compensation for local access and VAS service providers*
VAS provider	*Increased user base resulting increasing revenue, external billing service provided by the service broker*	*Tailored access related content*

Value proposition and Financial models:

The customer benefits from a targeted service experience improvement as the use of new networks can enable additional service experiences. The payment is coordinated through the user subscription even if the normal subscription does not have capability to handle the actual VAS service.

The visited access provider can resell some of its own service offerings as VAS service to visiting users.

The Home network provider / Service broker benefits from customer satisfaction even for services that it can not offer of even handle by itself. The new VAS service require no own additional investment to support the service but still user experience satisfaction is uphold through the VAS services.

The VAS provider can offer new services and target specific services and access networks for coverage. The customer base can be flexible and all customers at coverage areas can be served as long as the customer's normal subscription provider can agree on VAS subscription accounting.

Value network and Functional architecture:

The customer uses the tailored VAS service offered from the VAS provider through Access provider advertisements.

The visited access provider uses Home Network / Service broker verification of the customer, while the VAS service authorization is handled by the VAS provider. The VAS advertisement has to be supported.

The Home network provider / Service broker offers to its customers its identification and billing infrastructure according to their subscription also proxy VAS subscription billing service.

The VAS provider offers to its customers use of identification and billing infrastructure

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according to their subscription.

4.4 Case with roles supporting advertising using directories

The use of directories to collect advertisements and make them public enables different business options depending on to whom and how directories are provided. Directories could be public and open to anyone or they could be private and only open to subscribers of an operator or members of an alliance (cf. alliances in the airline industry)

A big question is how the directories should be updated; should it be done by access providers, by third parties (brokers) or by direct input from users with feedback on detected and used accesses. The management of information of directories seems to offer a possibility for establishment of a new business role of specific importance in the AN environment.

Within this context we also should mention user needs (which also can be advertised as solicitation messages as triggers to providers to send offers). The user needs are used for searching directories for proper offers and this task could be handled by a third party. So for support of AN advertising we can envisage a new business role, the "AN advertiser broker" with contacts with many users and providers as illustrated in figure 6.
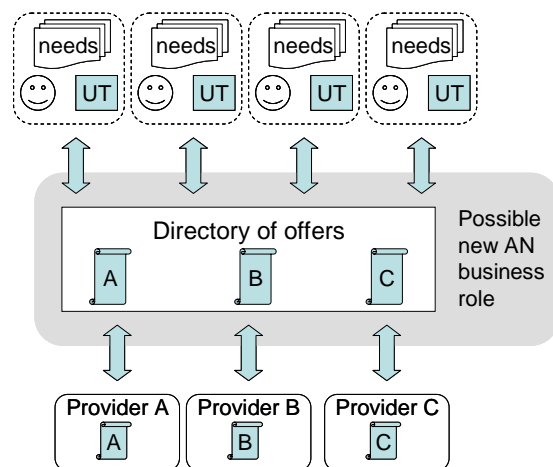
Figure 6: Market environment for AN advertising broker

This business role would be easy to combine with an "AN retail access broker" managing the establishment of connectivity between network providers and end-users. Furthermore this relates very closely to the cooperation with other business roles like service aggregators and trust managers proposed in [3] and [4].

The BBM analysis shows the same results as the other cases, the specific characteristics of benefits and offers are summarised in the table below.

Business Role	Gains	Offers
User	*Improved awareness of offers and more info for decision making*	*Payment*
Access and service providers	*Increased visibility to a larger customer base*	*Access and services*
AN advertising broker	*Revenues from both users and providers*	*Increased visibility of offers to a larger customer base to providers, Ease of use and reduced complexity to users.*

5 Conclusions and discussion

The initial findings in phase 2 of the project indicate that the proposed, mostly technical, composition concept shows a high potential to be used as a "tool" for making business, including how to establish and maintain business relations and to handle related negotiations and transactions made "on the fly"

The case studies in this report provides examples of how AN composition framework and new business interfaces provide opportunities to make business in new ways, to create new value networks and enable new business roles to emerge.

To fully exploit the opportunities in the business domain, a number of business concepts have to be developed in parallel with the development of architectures, interfaces and protocols. From end users point of view, it is important that the technical complexity and all dynamics in the (business) relations between different authorities like operators and service providers and in their content is hidden and does not require any additional user actions.

It is equally important that end users' preferences are considered while advertising and establishing new relations, since even if we are able to provide "pervasive" connectivity for users, it still remains to be a fact that users' main interest is to use services that are provided over this connectivity. The dynamics among authorities forming networking and service infrastructure does not need to reflect to relationships between end users and subscription providers, one could even argue that these relationships should be relatively static considering all human actions required nowadays to setup such a relationship like mobile subscription. However, it is possible that end users will see this change of networking and service infrastructure with increasing number of subscriptions. But with a proper subscription management, a user does not need to be aware of what subscription is used and when, thus these subscriptions are selected and handled automatically according to user's location and communication context.

The table summarizes the relations between businesses roles and what is provided to whom.

	User	Access provider	Access broker	Service provider	Service broker	Directory service	Credential issuer
User		Local access	Overall access & connectivity	Content, subscription and billing	Content, subscription and billing	Info on available offers	Trust management Acts as TTP
Access provider	Payment		Broker services	customers content & accounting	Broker services	A channel to distribute offers	Acts as a TTP
Access broker		Provides a channel		customers content & accounting	customers content & accounting	A platform for broker services	Acts as a TTP
Service provider					Billing & accounting, delivery channel	A channel to distribute offers	Acts as a TTP
Service broker						A platform for broker services	Acts as a TTP
Directory service							Security check for provided info
Credential issuer	Consumes credentials	Consumes credentials	Consumes credentials	Consumes credentials	Consumes credentials	Consumes credentials	

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EU disclaimer

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