

Business roles enabled by Ambient Networking to provide access for anyone to any network and service

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Abstract

This paper will describe roles and market actors enabling new forms of co-operation and competition using Ambient Networks technology and concepts. According to the Ambient Networks vision “any” user will be able to connect to “any” network, which will challenge traditional “one operator – one subscriber” solutions. Ambient Networks will stimulate an unbundled value network but will also facilitate the dynamic and flexible way of doing business in an environment with many access and service providers. The roles described in more detail in this paper are the Local Access Provider, Access Aggregator, Access Broker, Trusted Third Party, ClearingHouse, Compensation Service Provider and Service Aggregator.

Keywords: Ambient Network; business relation; business role; Local Access Provider;; Access Aggregator; Access Broker; Trusted Third Party; Clearinghouse; Compensation Service Provider; Service Aggregator; Network Composition.

1 Introduction

Today, Mobile Network Operators (MNOs) provide a majority of mobile services and access to customers based on vertically integrated value chains. Customers are usually restricted to a particular operator’s network of which they have a postpaid or prepaid subscription.

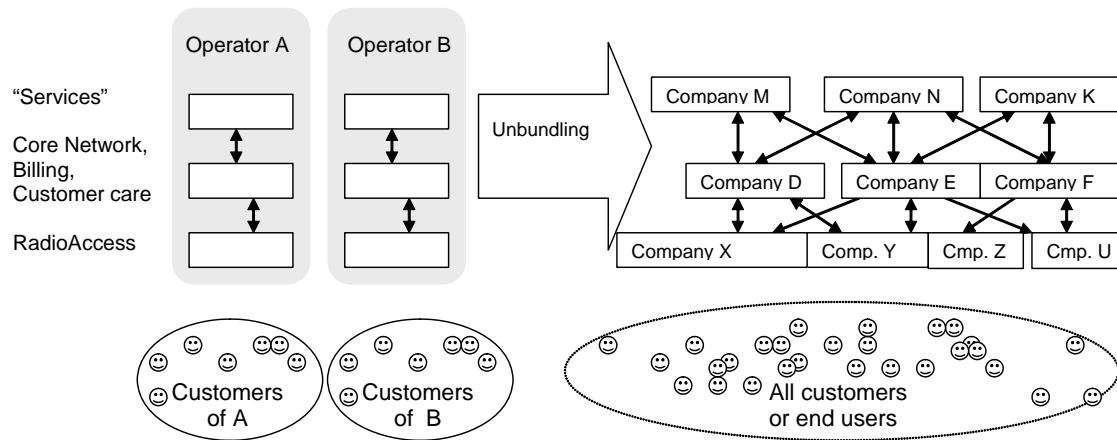


Fig. 1. A schematic presentation of the disintegration of the current market structure into a fragmented market structure consisting of a multitude of actors.

Currently, the communication and information industry is facing large structural changes driven by new regulatory frameworks pushing disintegration or unbundling as well as driven by internal restructuring like data-voice and fixed-mobile convergence. Moreover in the future new networking technologies will be introduced. Hence, one may expect a multitude of new ways to deploy and operate networks, as well as new business roles and relations, and new forms of cooperation [2].

New types of actors can emerge as a result of disintegration of the vertically integrated value chains typical for today's MNOs, see Figure 1. Cooperation between operators and local networks deployed by users in homes or offices will also result in the need for new types of roles, either as part of the traditional MNO or as an independent actor. MNOs are believed to be well suited to fulfill many of the new roles in the disintegrated market, as well as being able to find new ways for inter-operator co-operation.

In this paper we will describe roles and market actors enabling new forms of co-operation and competition using future Ambient Networks technology and concepts. Currently, in the EU integrated project Ambient Networks (AN) a new network architecture is being developed [1]. that supports access for *any* user to *any* network. With access to any network the users will experience a higher service level with increased availability and reliability as well as increased quality. With the AN functionality for multi-radio and multi-operator access the service can be offered at lower production costs through more efficient deployment and use of resources. For cooperating Access Providers the production cost and the investment risk can be lowered further through sharing of networks and re-use of user-deployed networks resulting in less need for over provisioning. Furthermore, cooperating providers will also get access to a larger potential customer base [6].

In the next chapter we give an overview of the Ambient Networks project where most of the research presented in this paper is conducted. In chapter 3 we focus on the Network Composition as major business enabling function of AN. After that in chapter 4 the roles that become more important through AN are described and the value network with these roles is analyzed in chapter 5. Conclusions are presented in chapter 6.

2 Overview of the Ambient Networks project

Although the Ambient Networks project focuses on new networking technologies the strategic goals are very much driven by business and market considerations, as can be understood by the objectives section in the project definition [1]: "The Ambient Networks project aims at an innovative, industrially exploitable mobile network solution, which enables the composition of networks across business and technology boundaries in order to stimulate new business developments and growth in the wireless domain. The strategic project goals are:

- to define an affordable and scalable mobile communication network, that opens up new ways to communicate, for billions of people and devices,
- to facilitate "ambient networking", allowing increased competition and cooperation, enabling efficient use of resources in an environment populated by a multitude of devices, technologies and business actors,
- to achieve a broad industry consensus on ambient networking, creating new business opportunities for mobile network service provisioning,
- to develop a solution that provides easy to use, rich and trustworthy multimedia services for all".

2.1 Business modeling in Ambient Networks

As stated above the strategic goals of the Ambient Networks project are driven by business and market considerations. That is why special attention was given to feasibility and business modeling in various parts of the project up till now. The focus in this paper is on new roles and thus on the value network.

Following the Business Blueprint Method [3] of business modeling the value network can not be seen separate from the value proposition, the functional architecture nor the finances. So, in this paper these topics will be touched upon in general and qualitative terms.

The value proposition of AN can be summarized as providing increased availability and reliability of network access, as well as providing value added services to end users that will experience this as increased quality in an easy to use and affordable way. In order to discuss the new roles in more detail later the following section provides an overview of all roles and the value network. After that we look into a vital part of the functionality that AN provides: compensation.

Overview of business roles in Ambient Networks

In order to provide an affordable mobile communication network for much higher bitrates and more people, it is not feasible to continue building denser networks and more base station sites [7]. The consequence is that parties need to cooperate on certain levels while competing on others, e.g. by allowing customers of other operators to access the “own” networks. Figure 2 illustrates the multitude of market actors and roles that are currently discussed within the AN project including network operators, service providers and also different forms of “middlemen” or trusted third parties [2].

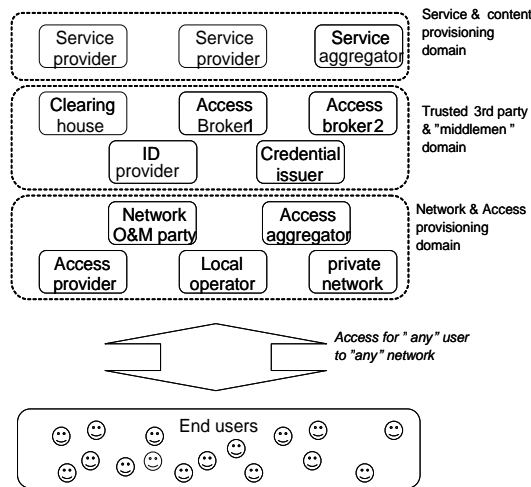


Fig. 2: Overview of business roles in Ambient Networks.

In order to get solutions of AN implemented the business opportunities need to be clear to all. All these new technologies in an environment of many business actors are bound to create too many options. So aggregation is needed to keep it usable to end-users as well as business actors.

Discussion of new business roles will focus on what is called the final migration stage “native Ambient Networks”. However AN can migrate in several logical steps from current networks and market structures to this native stage. Looking at the final migration stage means that the market structure will be adjusted to reap the benefits of the AN technology. So probably it is

a flexible and unbundled market in which small Local Access Providers will for instance cooperate with big international Service Providers.

3 Network Composition

3.1 Introduction

In an unbundled and dynamic market with many Access and Service Providers flexible and ad hoc cooperation is a key aspect. Network composition (or just “composition”), is the concept for how Ambient Networks interconnect *dynamically* in order to make use of services and resources available in or via interconnecting Ambient Networks [5]. Composition applies on a global scale and is possible and supported for any level or size of networking. Through the inherent support of dynamic networking, it also means that business agreements between interconnecting networks are supported as run-time operations. This together with that composition is defined generically for any type of network (and of any size), provides for a platform of very efficient and scalable deployment of new technologies, applications, and services.

Network composition can support many different use cases, e.g. a Personal Area Network interconnecting with a residential network, a train network with a cellular network or carrier networks connecting to offer dynamic Service Levels. Already mentioned are the dynamic roaming agreements, where neither the user, nor the visited network needs to have any prior arrangements with a home network. The necessary agreements can be established at the time the user roams into the visited network. Moreover, they could make it possible that the user does not need any prior arrangements with any network/service provider, i.e. the user can be seen as “homeless”. Another example is a community network, even a residential network, composing with a MNO to provide extended coverage and capacity.

3.2 The composition process

The composition process includes Media Sense, Discovery/Advertisement, Security and Internetworking Connectivity establishment, Composition Agreement Negotiation, and Composition Agreement Realization (see Figure 3). 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 to certain, trusted ANs.

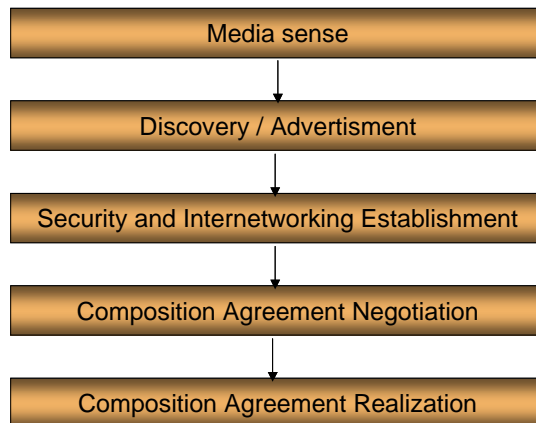


Fig. 3: Phases in the composition process.

- **Media Sense**
The very starting point is to sense a medium that would enable communication with a neighbouring node, another network or device. The “sensing” also includes the case of discovering a link to a remote AN.
- **Discovery / Advertisement**
Depending on the situation, the phase of Media sensing is followed by either an advertisement or a discovery phase. With active advertisements an AN can offer (network) resources and services to other ANs. The AN may alternatively listen to advertisements by other ANs, or actively discover its neighbours and request information of access or service offers. The Advertisement/Discovery phase allows to select a candidate AN for composition. It allows discovering other ANs identifiers, resources, capabilities and (networks) services.
- **Establishment of Security and Internetworking Connectivity**
When the Advertisement/Discovery phase discovered a candidate AN for composition, the two ANs need to establish basic security and Internetworking connectivity. Cryptographic identifiers belonging to the ANs involved in the composition are used to bind the established shared key to the communicating ANs and a cryptographic puzzle is used to protect against Denial of Service. The identities of the ANs might be authenticated and/or authorized using a Trusted Third Party. Alternatively the required trust relationship may be based on a pre-established shared secret or may even be opportunistic, e.g. the ANs make a leap of faith, trusting the unauthenticated identities.
- **Composition Agreement Negotiation**
The next step of the composition process is the negotiation of the Composition Agreement (CA). The CA includes the policies to be followed in the composed AN, the identifier of the composed AN, how logical and physical resources are accessed, controlled and/or shared between the composing ANs, how to deal with charging and billing, etc. Where the CA includes commercial factors, the CA should be digitally signed by both ANs to provide non-repudiation. It is possible that the process of establishing a CA may involve increasing levels of authorization, e.g. negotiation of certain resources and services may only be authorized once the two ANs have agreed the commercial aspects of the CA. Since the composition agreement is an important requisite for the composition process this will be further discussed in section 3.3 below. A special section on billing negotiations is included in 3.4.
- **Composition Agreement Realization**
The Composition Agreement Realization phase represents the completion of the composition. During this phase, network elements are configured to reflect the CA. Thereby, each of the composing ANs must also carry out the configuration of its own resources by updating the policies and of their control functions. A fundamental issue after composition is that some signalling must be exchanged between the ANs involved in the composition, e.g. status and control information, to maintain the composition state. This could also include information that is normally exchanged during the Advertisement/Discovery phase, and which could lead to a re-iteration of the composition process or even the request to de-compose.

3.3 The composition Agreement (CA)

Ambient Networking is about cooperation among networks, and this implies that there are a lot of different issues that need to be arranged between the networks involved. When establishing an inter-network agreement today (e.g. for interconnect or roaming), typically the non-technical aspects take most time to agree. Since the goal of composition is to enable networks to cooperate easily, it implies that the establishment of the composition should be done “on the fly”, therefore speeding up the process of negotiating and execution – and eventual release – of cooperation. Therefore, the aim of Composition Agreements is to agree on technical and business aspects to some degree automatically. It is also necessary that these agreements are established in a secure, trustworthy way.

The wide scope of a Composition Agreement implies that a huge number of parameters, values and options need to be agreed. Negotiating¹ all these parameters and values may require a lengthy process which conflicts with the idea to negotiate CAs on the fly. Fortunately, some more generic elements of these negotiations can be done in advance using composition agreement templates. This template predefines parameters, values and options for a CA. For specific use cases, the parameters that should be agreed are generally the same. By using an applicable composition agreement template in a composition process one greatly reduces the amount of negotiation and time needed. Standardisation bodies could define composition agreement templates. An example is the GSM Association that in a way defines a template for roaming agreements. A CA template could include the following items; ID, Service description, QoS requirements/guarantees, Legal issues and financial issues, monitoring and performance reporting, problem and failure reporting [4].

3.4 Compensation

To ensure commercial viability for all the different business roles, the composition process needs to deal adequately with charging and billing. We term this *Compensation*, i.e. basically, the charging party provides some service for which it gets compensated. Figure 4 describes this basic compensation case:



Fig. 4: Basic Compensation Case.

The Compensation Process requires, as any specific billing process, the usual functionalities like *accounting* where the information related to the chargeable events is generated, *charging* where the accounting details are collected and rated, *billing* where the charged events are transformed into invoices, *presentation* where the invoices are presented to customers electronically or on traditional paper, and finally *payments* where the presented invoices are paid by the customers and settled by the compensated party.

Since Compensation aspects are fully related with the characteristics of the services being offered, they cannot be negotiated independently of other aspects of the service. Therefore Compensation Issues are part of the Composition Agreement. It must be noted that compensation is not only an issue in composition but also in decomposition. For example, if the compensated party does not provide the service any more, re-compensation -as long as it is manageable- could be attempted.

¹ Not all parameters need “negotiation”. A lot of parameters imply simply an exchange of information (e.g. supplying addresses, names, bank numbers, et cetera)

4 Description of business roles

Through the new capabilities that AN offers not only end-user services will change but also the way these services are delivered and by what kind of actors. Because services and access will be independent and every network will be accessible other roles become more important than at present. So we will analyse these roles and how AN influences the way they conduct business with the end user as well as amongst themselves. After describing these roles in this section we will in the next section place them in an integrated and a disintegrated value network and discuss aspects of relations like cooperation and competition, transaction costs and some other financial aspects.

- **Local Access Provider (LAP)**
A local access provider is a business role offering local access / local network resources for local communication. Combining local resources with nationwide networks will possibly reduce production and operational cost of network access achieved through more efficient resource management and through “re-use” of local infrastructure and user-deployed equipment using AN technology. E.g. this means that a chain of shops with a wireless access point in each shop can be a local access provider to its clientele. Local access providers will most likely always be combined with the role of Local Service provider as they offer access services and probably some services that use the access to target the local customers. In general Local Service Providers offer content and services for a local market and/or local context. Entry barriers will be lowered since AN supports a multitude of network providers, i.e. many channels to the customers. Local Service Providers that will offer content and services for a local market and/or local context can emerge supported by the advertising and service discovery functionality of AN.
- **Access Aggregator**
What about the total number of LAPs? Although there will exist LAPs with national presences (e.g. food store chains), we believe that most LAPs will be truly “local”. This means that there will be hundreds or thousands of LAPs in a large town or city. To handle this multitude of local providers the type of actor exemplified by the access aggregator will likely emerge. This is a business role that aggregates and bundles the different radio access services bought (or supported) from (local) access providers. This access will thereafter be sold either to *service aggregators*, or to *access brokers* offering an intermediate step. The role of access aggregator can exist within a MNO but also as an independent actor.
- **Access Broker**
A particular important type of capacity broker, dealing with “brokerage” of access capacity, i.e. offer and manage end-to-end connections between the service aggregators, service providers, etc. and the access aggregators and the access providers. An access broker could also have billing relationship with customers, hence we can distinguish between two different types of brokers; i) the retail Access Broker, offering capacity directly to the end-users, and ii) the wholesale Access Broker, offering the capacity to other players like MNOs, MVNOs or to Service Aggregators.
- **Service Aggregator**
This role provides an aggregated service to customers by bundling services. This is mainly a marketing and customer relations role providing a one stop shop to customers for a variety of services. Today there exist a few MNOs in every country, each with many

millions of “well known” users. Most users have a subscription with one MNO only. In the envisioned scenario, on an everyday basis, a user may use access and end-user services from 10 – 100 different local network providers or LAPs. In total a user may have used thousands of LAPs during a year. To make the daily life easier service aggregators and retail access brokers can act on behalf of the users. From the LAP point of view hundreds or thousands of different users may access the network every day, as mentioned before the agreements will in most cases not be pre-negotiated.

Higher availability of services, allows for better economy of scale since it is exposed to a wider user audience in more locations. Furthermore the seamless combination of networks combined with the possibility of aggregating services has the potential to offer new kinds of service bundles.

- Trusted Third Party (TTP)**
 This entity facilitates interactions between other parties who all trust this entity. By using this trust parties secure activities like e.g. authorization, ID management and payments. For example, a Trusted Third Party (TTP) may fulfill a notary function by authenticating entities or signatures on agreements. Note that traditional operators looking for new business opportunities and a crucial position in new value webs could play this role. Also strong security authorities like billing and payment service providers, financial institutes like banks or credit card companies could naturally take this role.
- Compensation Service Provider (CSP)**
 This is a business role offering compensation services to parties who have to compensate each other for delivering services. In this respect the Compensation Service Provider is an entity that helps two parties getting the compensation done while e.g. they themselves have not the adequate compensation functionalities. One may expect that big traditional parties like MNO play this role themselves. We note that here we describe Compensation Service Providers offering retail compensation services. In this view the Clearinghouse entity described could be seen as a wholesale Compensation Service Provider. In fact a dedicated party in the market could play both roles together moreover since wholesale compensations are aggregations of retail compensation details.

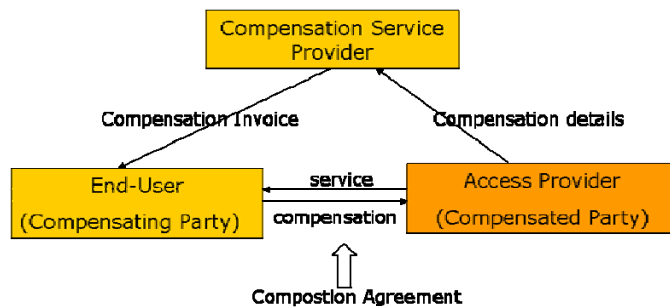


Fig. 5: Presentation of the business entity: Compensation Service Provider.

- Clearing House**
 This entity provides a clearing solution to parties who have to pay each other due money since their own customers have used services of the other parties. Hence a Clearing House settles wholesale demands including agreed revenue sharing. This role could be played by a specialist party in the business-to-business market. Another possibility is that for example an aggregator who bundles access or services for customers also fulfils this role.

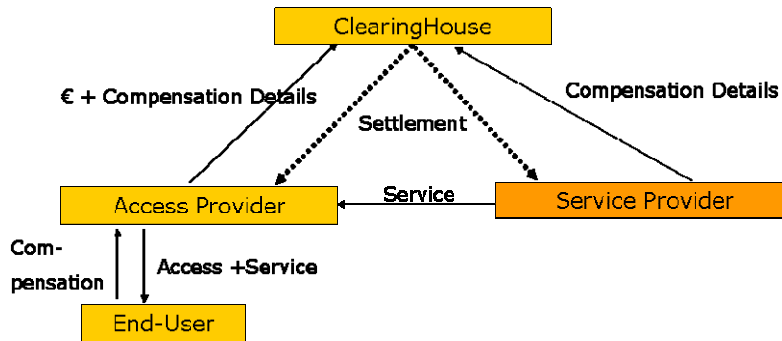


Fig. 6 The business entity Clearing House settles between the Access Provider and Service Provider the compensation of the End user using the services.

5 Analysis of roles and value network

5.1 Value network

An example of the envisioned roles and their relations is presented in Figure 7 below. Even though the figure only includes the most important roles of the value network it is easily understood that the market structure is highly challenging and numerous different *value configurations* are plausible.

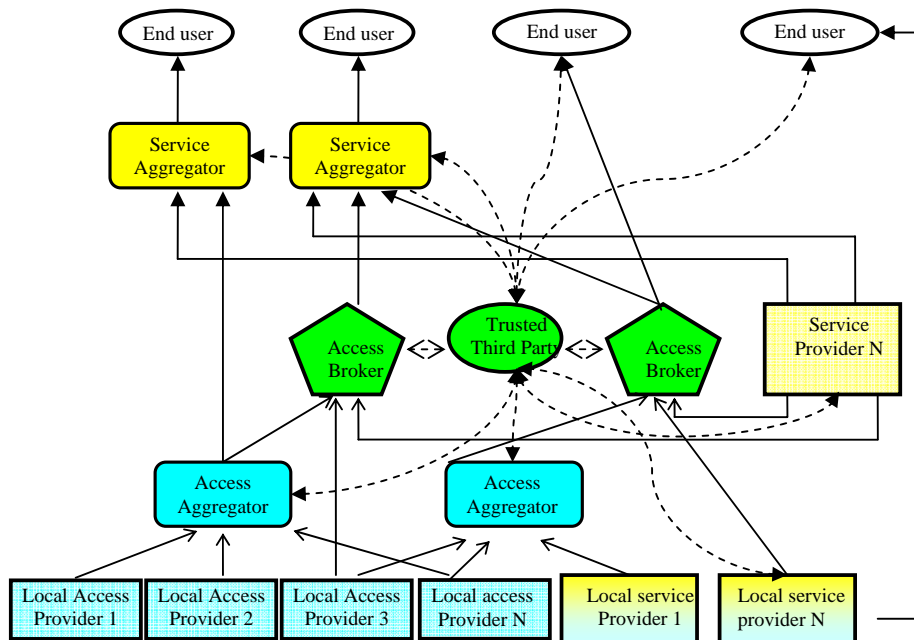


Fig. 7: Presentation of the value network for a fragmented market structure. The solid lines indicate services flowing in the direction of the arrow, implying that a monetary compensation is required in the opposite direction. The dotted lines indicate trust relationships. Aggregators are presented as rounded rectangles whereas the brokers are shown as pentagons. Clearin House and CSP are not presented in this picture to reduce the complexity.

One of the challenging aspects within fragmented market structures is, as can be seen from Figure 7 that there will be numerous relationships between existing roles. The actual level of fragmentation of the market will to a large extent be determined by transaction costs related with forming and sustaining a relationship with other actors. If AN fails to reduce the

transaction costs considerably -compared with the ones in current market structure- a consolidated version of value networks where all actors encompass several different roles will develop. Naturally, this will reduce the fragmentation (and consequently also the competition) of the market structure, in the extreme rendering a similar structure as today. Thus, for this scenario *composition constitutes a crucial functionality and apart from simply providing the technical solutions the functionality also has to be designed in such a fashion so that the amount of business sensitive information is kept at a minimum level.* We believe that in many cases, and especially within the fragmented market structure, one has to outrank the technical merits (e.g. the capacity) of the solution. The fact that consumers would like to have only one billing (or compensation) relation will most likely consolidate the number of actors and we envision that the role of the Access Broker and Trusted Third Party in many cases can be combined.

Table 1: Summary of possible relationships between business roles (middle column) present in the value network (Figure 7). The columns to the left describe the producers and the production factors used by the investigated role for producing the output, which is presented to the right and provided to the next role in the value network (buyer). Again Clearing House and CPS are not included as they were not included in Figure 7.

Producer	Input	Role	Output	Buyer
	Infrastructure, Frequency license	Access Provider	QoS assured wireless access, Measures on data usage	Access Aggregator, Access Broker
	Infrastructure*	Local Access Provider	Wireless access	Access Aggregator, Access Broker, LSP
Access Provider, LAP	Different types of wireless access (licensed, licensed exempt)	Access Aggregator	Bundled RA services with E2E connectivity	Access Broker
Access Aggregator, Access Provider, LAP	Bundled (or unbundled) RA services	Access Broker	Bundled RA service including E2E connectivity	Service Provider or Aggregator, Consumer
All		Trusted Third Party		All
Access Broker and Aggregator, Access Provider,	Bundled RA services	Service Provider	End-user services (e.g. content-based)	Service Aggregator, Consumer
Service Provider Access Broker	End-user services	Service Aggregator	Bundled end-user services (service portals)	Consumer,
(Content providers)	RA services, Location specific information	Local Service Provider	End-user services	Service Aggregators, Consumers
Service Aggregator (Retail) Access Broker, TTP	"Monthly" Bill	Customer		
Service Aggregator, Retail Access broker	Bundled services	End-user		

5.2 Roles & Relations

Access and Service Providers can choose to co-operate horizontally or vertically. It is obvious that AN increases the opportunities and incentives for horizontal co-operation. But is it beneficial for a Local Access Provider to co-operate with the local competitors? Cooperation is needed to hand over end-users seamlessly from one network to another but

this will only be done if both parties will enjoy the advantages. From the end-user perspective “continuous connectivity” is a kind of service that represents an added value and hence could be paid for. From the Service Provider perspective it would also be more beneficial to cooperate with Access Providers that are willing to contribute to “continuous connectivity”. For a disintegrated market scenario we envision a market structure characterized by “fierce” competition between different Access and Service Providers. At the same time some actors will cooperate on long-term basis, e.g. form alliances depending on their corporate strategy and their position in the value network. It can be argued that the large number of both Access and Service Providers will result in a need for aggregators that act as agents for other actors by managing the complexity of the business environment. Examples are the Service Aggregator acting on behalf of end-users, and the Access Aggregator acting on behalf of LAPs

Assuming a migration path with increasing dis-integration of vertically integrated MNOs a certain development of roles can be seen. Starting at the vertical integrated market with little cooperation, it is plausible that the role of access aggregator within an operator can be identified. In this role the multiple Access networks of the operator are composed to work as one seamless network. Besides that the MNO will incorporate several local networks were it is efficient at that point in time to use the available infrastructure instead of building it themselves (Figure 8). In the same way, the role of Service Aggregator is played to aggregate and integrate the own access and services into one seamless bundle and handle all customer relations. The service bundle will be complemented with services from Service Providers like banks or music distribution companies. The actors and their mutual business relations in a market with vertically integrated value chains with a high degree of cooperation with independent access and service providers are illustrated in Figure 8.

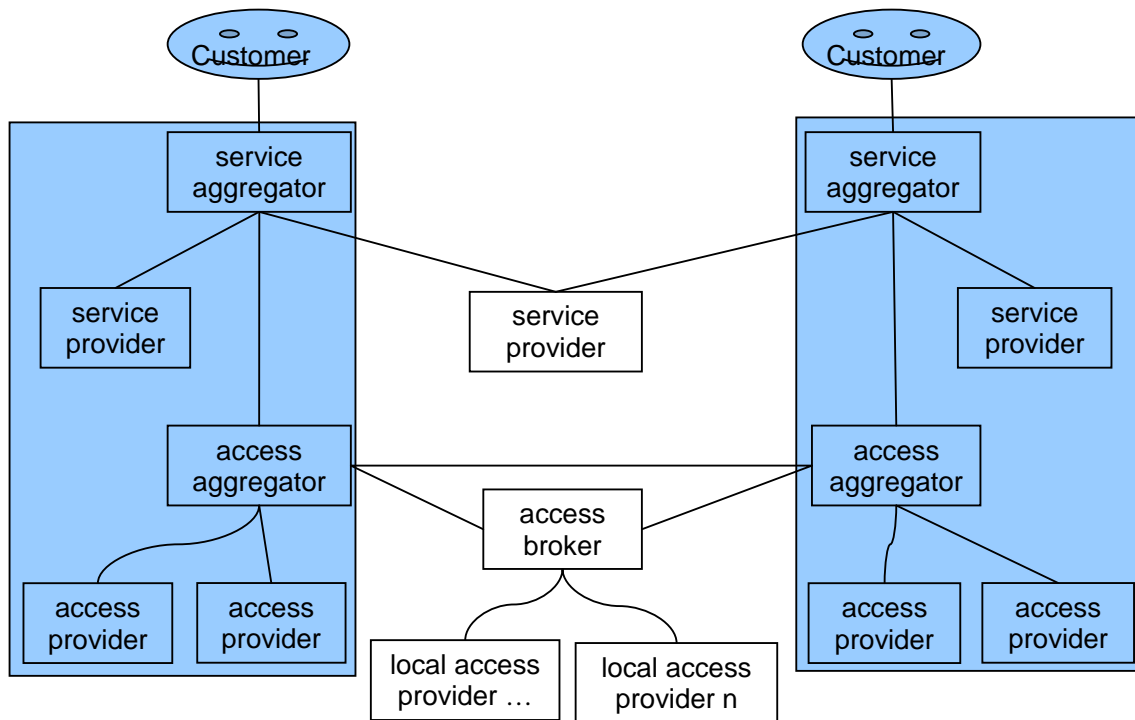


Fig. 8: The actors and roles in a market with vertically integrated value chains with a lot of cooperation and their mutual business relations.

The next step in cooperation is when Access Aggregators are going to share resources with each other. This might be buying extra capacity when needed and selling spare resources. This would be a role for an Access Broker to organize this market. AN technology will help to make this a seamless experience for the customer and automate large parts of the buying and selling. The Access Broker can provide another service next to the market place, since it can act on behalf of LAPs, providing bargaining power as well as a one-stop shop. Furthermore the Access Broker can use aggregated access of a vertically integrated operator as a wholesale offer. A LAP can generate extra revenue when it joins an Access Broker by opening up their networks for others. LAPs can also sell valuable context information –like location- that they have of the local users.

At this point services are available from independent Service Providers and access is available from Access Brokers. This means it is possible to take up a role as independent Service Aggregator (not being part of a MNO) bundling services and access and target this bundle at a certain customer group.

The multitude of independent roles and the multitude of actors that can play a role will make it necessary to have one more intermediate roles. Instead of passing identity, security, authorization, profiles, preferences and payment information from one provider to another it will be better for all to have a central party that manages this, the TTP. These roles and relations are visualized in the right hand side of Figure 9.

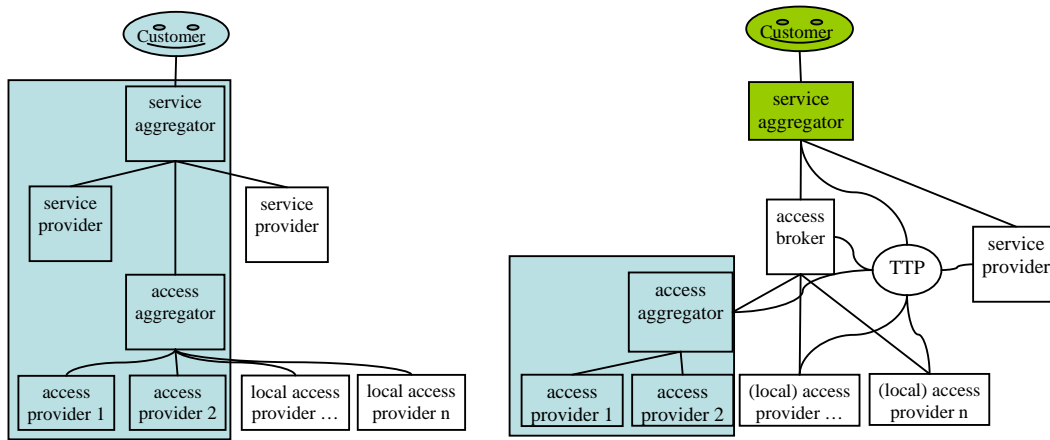


Fig. 9: To the left; the BLUE operator acts as an Access as well as a Service Aggregator, To the right; the independent GREEN Service Aggregator (acting on behalf of the user) cooperates with an Access Broker and a TTP, here the BLUE operator is only an Access Aggregator.

For the customers it will be possible to buy access independent of services and services independent of access. In principle the Service Aggregator is not really necessary because the customer can take up this role for himself but most customers will appreciate a party taking all the burden of organizing, negotiating and buying all separate items of a complete service bundle. In the unbundled market scenario the differences over time can shift dramatically in terms of quality, costs, access and services available as ad hoc negotiations and network composition cannot be predicted. The financial risk involved can be taken by an intermediate role as a Service Aggregator because it spreads the risk over a large number of customers. An individual end user cannot spread the risk in this way.

It has to be realized that in the real world all possibilities will exist next to each other. There will always be vertically integrated operators offering a nice and integrated bundle of services and next to that will be independent providers of services and access. Some will cooperate and some will not. This will make a much more complex market as in one of the separate

figures. In order to make the AN world work, relations and negotiations, resulting in sharing of resources, are a focus point. If there is an intermediate role in the middle or not it is important that all information is available to check if for instance composing networks is possible and if services can use the available access and at what costs while maintaining a certain amount of security. All this information should be available, compared and agreed upon without the customer noticing or influencing the seamless service experience.

5.3 Financial aspects

An analysis of *cost per user* for amount of data transferred during one month is presented in [2] for the case where a MNO cooperate with LAPs and use part of their capacity. One conclusion that can be drawn from this analysis is that there is potential for significantly lowering the investment size, risk level and overhead costs if specialized local network operators exist and are willing to share their assets. This is enforced if these assets were purchased initially for other purposes. Moreover, a partnership with strong brand companies will reduce the marketing costs and open up more financial resources for network development.

One of the main points of AN implementation is to provide *lower transaction costs* among the multitude of players willing to cooperate in the market. As was suggested above, cooperation among horizontally specialized players is a must if they want to be independent of MNOs.

From a traditional MNO perspective, the *investment risk* in venturing into a new wireless service with unknown demand is considerable. This is a good enough reason to look for opportunities of minimizing the initial investment by sharing and reusing existing assets belonging to LAPs as well as marketing competence and brand of large corporations. By deploying their networks in selected areas with high population density, LAPs can develop a small scale but healthy business with low investments. One possible outcome may be that these LAPs can drive the deployment of broadband transmission lines for Internet connection to the areas where they deploy the infrastructure.

From the MNO point of view the cooperation with LAPs can present a more or less safe investment. Since the infrastructure is used by the LAP himself, the LAP is supposed to make the major part of the investment. If the agreement between the MNO and LAP also includes “access to all traffic”, both internal and public, the MNO will experience lowered costs for customer acquisition. For companies the internal traffic can most likely be considered to be both stable and established, thus this represents a low risk investment for the MNO.

6 Conclusions

This paper introduced the AN concept of any user connecting to any network and the main concept of ‘composition’ to enable that. It was shown that this technology enabled new business models and new business roles to be played by new actors and that compensation is an important part of that to conduct business. We analysed the roles within a value network and discussed various business models.

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