

Pervasiveness in Converged Telecommunications: A Business Opportunity for the Operators

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Abstract: Mobility has become a central part of the lives of European citizens. Rapid technological development in the areas of mobility and telecommunications has resulted in not only a bewildering technology picture, but also uncertainties regarding business models and the roles that different businesses can play within this new picture. In this paper we take the concept of pervasive and ubiquitous services as a starting point and outline a new value network, where Service and Network Aggregators cooperate with multiple content / service providers and access network operators respectively. In this new value network, we evaluate the opportunities for telecom operators and we investigate some novel business models with varying degrees of changes and adaptation required to the current market and business roles for telecom operators. Finally we discuss a service framework that provides a flexible and precise basis for the analysis of the above roles and business models.

1 Introduction

“Bart is at home watching his personalised newscast and receives incoming voice call from boss. Newscast is put on hold; the call is from Bart’s boss who instructs him to go to the airport to pick up Rosalyn. Bart’s Boss sends the Virtual Identity (VID) of Rosalyn to Bart’s ToDoList application. Without hanging up the call, Bart leaves home, and heads for his car. The voice call is automatically put on hold, Newscast is also still on hold. Bart enters his car and is automatically authorised on the car terminal. Voice call is retrieved on the terminal, and as he drives away the terminal switches from the home local network (WLAN1) to the mobile network (TD-CDMA) [...] Bart arrives at the airport. His navigation system guides him to the proper gate at the airport and leads him to the reserved parking lot. Car terminal switches automatically from digital broadcasting (DVB-T) to the WLAN3 that is available in the airport, and displays some airport information carousel. Specific information about Rosalyn’s flight is displayed on the screen: delayed flights are shown [...]”

This is a scene extract from the Automotive Mobility scenario, one of the two scenarios that the DAIDALOS project uses as a driver for its research and development activities. The DAIDALOS project (<http://www.ist-daidalos.org>) aims to make the future "Beyond

3G" telecommunication networks user friendly by providing a pervasive interface towards the variety of advanced mobile services offered through such networks. The convergence of mobile and broadcast services and technologies is addressed through a common IPv6 framework and architecture. The project's consortium consists of 46 partners who represent all the value chain for development and provision of advanced mobile services

As mobility has become a central aspect of the lives of European citizens - in business, education, and leisure, there has been a bewildering proliferation of technologies and applications for mobile users, accompanied by a plethora of access devices. At the same time, the infiltration of the Internet in all aspects of our lives, and the radical evolutions in services' concepts and networks' interoperability, are leading a huge number of companies - representing a large diversity of sectors, with different sizes, global/regional scope, cultures and commercial models - into a global converged market.

More and more, markets that have been formerly distinct, discrete and vertical in nature are coalescing across their traditional boundaries. The convergence of the different networks and the integration of the telecommunications and media value maps create a totally new map with a series of new roles to be acquired [1]. Established players in the previously separated digital content markets of the Mobile world, the Internet world and the Broadcasting world will now be challenged to re-evaluate their positioning on a common playground, moving from their traditional position to either defend their position or to make full use of the opportunities that the new value map provides them. New entrants will emerge and key technology-enabling players will gain value.

This has created a complex and confusing communications environment for users but also a challenge for traditional network operators who face the threat of losing their established market position of power. But content is not king [2], and seamless access becomes even more important in this emerging converged market. In this paper, we will argue how the operators can react to this challenge and even turn the threat into an opportunity by exploiting the key ingredient to the successful convergence so that users are able to use personalised services transparently from the underlying networks and technologies: pervasiveness.

2 Objectives and methodology

The objective of this paper is to evaluate the opportunities for telecom operators in the converging telecommunications market by investigating the converged value network and proposing novel business models with varying degrees of changes and adaptation required to the current market and business roles for telecom operators. In this context we try to define a flexible and comprehensive network of roles and relationships that may incorporate both traditional business concepts and best-practice models from existing value chains, as well as novel concepts coming from technological and social evolutions. A service framework for the proposed value network is also defined to reveal the value potential of the different roles in order to identify the most promising business models.

Value chain analysis gained popularity since Porter [3] formalised the concept in 1985. The concept has since been broadened and is often used to describe an entire industry and enables analyses of the positions of various firms in the overall industry as well as instances of vertical integration or cooperative agreements (alliances, joint ventures, etc.) in "business webs" [4] or "value networks" [5]. In the role model we are proposing, we are incorporating certain sets of business functions and processes that are associated with service deployment and delivery, into "business entities". One important criterion for defining a business entity in such a way is the potential for existence in real-life as an autonomous business, or as a department / sub-unit in a more complex real / virtual business organisation. The perspective taken in this investigation is operator-side, i.e. provides an insight to the business opportunities for traditional mobile / fixed network

operators to reshape/reposition their business in the emerging converged networks and services landscape.

This paper is based on the following methodology used in the DAIDALOS project for studying business aspects and proposing appropriate business models:

- Phase 1: Concept definition. The envisioned marketplace is assessed by the market drivers, technology drivers, novel service offerings, and stakeholders strategic positioning in a converged telecommunications market.
- Phase 2: Business Modelling Framework. The roles and relationships covering the full scope of the markets and technologies addressed are defined. This task is performed in close coordination with the architecture design in the project to assure business and technical requirements are covered in both modelling activities.
- Phase 3: Evaluation. Indicative business cases based on the driving scenarios of the project are separately or jointly evaluated through market planning, and appropriate investment and market financial evaluation, including interest, sustainability and competition issues.

Phase 3 is not completed yet in the project, so for the objectives of the work presented here the business models are evaluated based on an indicative opportunities assessment rather than detailed business cases.

3 Concept definition: from convergence to pervasiveness

To date, the component segments of the Information, Communication and Entertainment market have operated largely in parallel, each defined essentially in supply side terms, with their own distinct definition of the end-customer [6]. Television is marketed to viewers and subscribers, fixed telephony to subscribers, radio to listeners and print to readers and so on. The fact that these people are one and the same has not yet shaped the marketplace.

The customer tomorrow will be an individual who uses technology, information, and intelligence to save time and money, reduce inconvenience and risk, and open up opportunities in every area of life [6]. This will be achieved using whatever connections are necessary between people, interface devices, information, content and applications. This process will take place across all aspects of an individual's worlds, going beyond his or her 'consumption' activities to take in other roles such as worker, parent, club member, traveller, spectator or enthusiast.

The vision of a true Information Society is based on the vision of 'ambient intelligence' with people benefiting from services and applications whilst supported by new technologies in the background and intelligent user interfaces [7]. However even today's emerging wireless communications marketplace is too technology centric. The Information Society vision can only be realised when technology becomes invisible, allowing service self-adaptation to user requirements and context. This vision of "continuous immersion in computation" [8], where supporting technology will act personalized and adaptable to changing needs and context throughout our every day activities - is at the centre of what we call universal, ubiquitous, pervasive computing. The value of this vision is already becoming evident to Mobile Network Operators in their effort to provide home-office services in seamless mobility [9]. Figure 1 depicts this transition objective.

Improved user experience offered by a pervasive service is not possible without a graceful collaboration between the network and the service. The service may need knowledge of the user's current context (e.g. location / whereabouts, time of day, language preference, etc), and this information is collected from the network nodes that are relevant to this context. This information is used to add context-awareness to the user experience, ranging from simple location indications to more complex service/terminals discovery and dynamic composition of available resources and capabilities that comprise the service. Ultimately, the service becomes completely dependent on the network, integrating network

capabilities as part of its functionality. Service preferences and user preferences may be consulted when choosing network bearers, or services may require more control over such decisions and could thus directly interface with low-level network functionality to control this process more.

An important outcome of this elevation of the role and complexity of the service concept is that more control can be allocated to the service itself, and to the actual consumers of the service. In such environment, the role of the service provider requires complex cooperation schemes with several business entities, which are dynamically setup or aborted, depending on the fusion of interactions within the service logic. Figure 2 depicts the challenges in terms of settlement between different entities and customer relationship in this service centric approach.

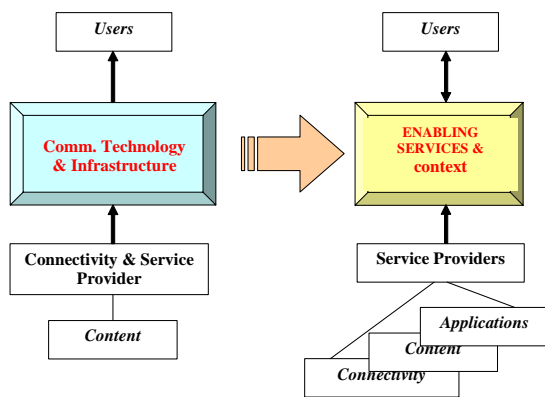


Figure 1 Service Centricity concept

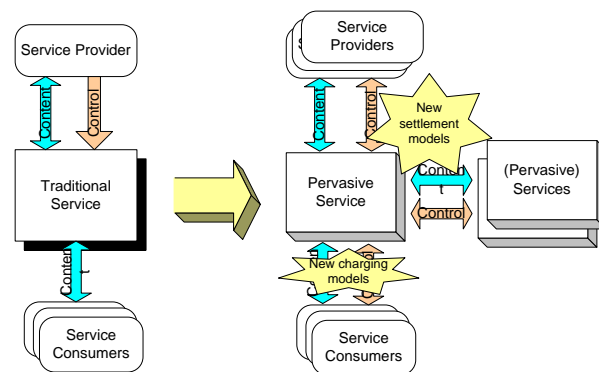


Figure 2 Pervasive Service Interaction

4 The new value net and the opportunities for the Operator

The vision of pervasiveness necessitates a rethinking of fundamental issues, in both technological and business context, to support seamless service discovery and composition based on context and profiles:

- Creation and efficient management of user-centred communication infrastructures for the future, based on an adequately modular and flexible architecture that allows multiple network bearers to be used for ubiquitous content / service delivery.
- Coordination of complex business relationships, with numerous players from previously unrelated market sectors.

Flexible new architectures that enable this vision are backed-up by business modelling activities such as the TINA-C [10], investigating specification of interoperability requirements between different business administrative domains. Standardisation fora and initiatives such as the TeleManagement Forum [11], Parlay/OSA [12] and Open Mobile Alliance (OMA) [13] propose business frameworks that standardise processes and interactions in an emerging market where horizontal competition, focused on value chain layers, is becoming as important as vertical competition spanning entire value chains. In the networked-home domain, for instance, the trend is to bundle services across a common infrastructure, thus sharing support and delivery costs to be economically viable. In TAHI Open Architecture (TOA) [14], a Service Provider can tailor a service to the customers' needs and equipment available in the service supply chain.

In the mobile market, the emergence of 3G systems seems to be a significant step towards a different model of telecommunication service provision. Moreover, evolving to B3G with a vast and competitive future market of services, traditional monolithic operator-centric value chains may be forced to give way to more fragmented models. Customer control, traditionally a stronghold of incumbent operators, as well as creation, development and offering of services will fall into domains which, in most cases, will be separated from

the access Network Operators (NO). Some Operators will be willing to outsource, or even withdraw from service provision and focus on their core expertise, which is network operation and maintenance (OSS). The goal is to avoid the cost and risk of in-house service implementation, which has to meet at the same time constantly changing market demands and preferences.

Operators that are looking to focus to the service provisioning will shift to aggregating (Value Adding) Service Providers and Content Providers, and possibly outsource their OSS to reduce operational expenses (OPEX). This entity, hereby referred to as Aggregated Service Provider effectively acts as a virtual service provider, interacting directly with end-users maintaining a separate database with user profiles and subscriptions for value added services. Its role is to bundle together different services into one-stop shopping, and to guarantee a stable environment for seamless provision of services over heterogeneous networks via a collaboration with one or more Aggregated Access Providers.

Aggregated Access Providers effectively come out of synergies between different converging industries (broadcast, mobile, Hot-Spot, Satellite), and their main role would be overcoming the fragmentation inserted to the market by diverse access technologies and numerous networks (already evident with the advent of public WLANs) by providing aggregation at network level (roaming, e-to-e QoS provision etc.). Aggregated Access Providers will work in a federation between to cover other access networks and roaming coverage.

Moreover, a key new role is necessary in this converged value web in order to provide pervasive services transparently to the user. The Pervasive Service Provider provides all the functionalities required for adding pervasiveness to a service. It encompasses all necessary service discovery mechanisms for services available from other entities in the value net (network information, location services, sensor services etc.) and composes them into enabling services related to pervasive support, i.e. personalisation, context management, event management, etc. Its central positioning in the value net also enables it to provide aggregated billing and virtual identity management for single sign on. The Operators are in an advantageous position to assume this key role based on their networking expertise.

Figure 3 depicts the value network based on the above concepts mapped on top the architecture developed within the DAIDALOS project.

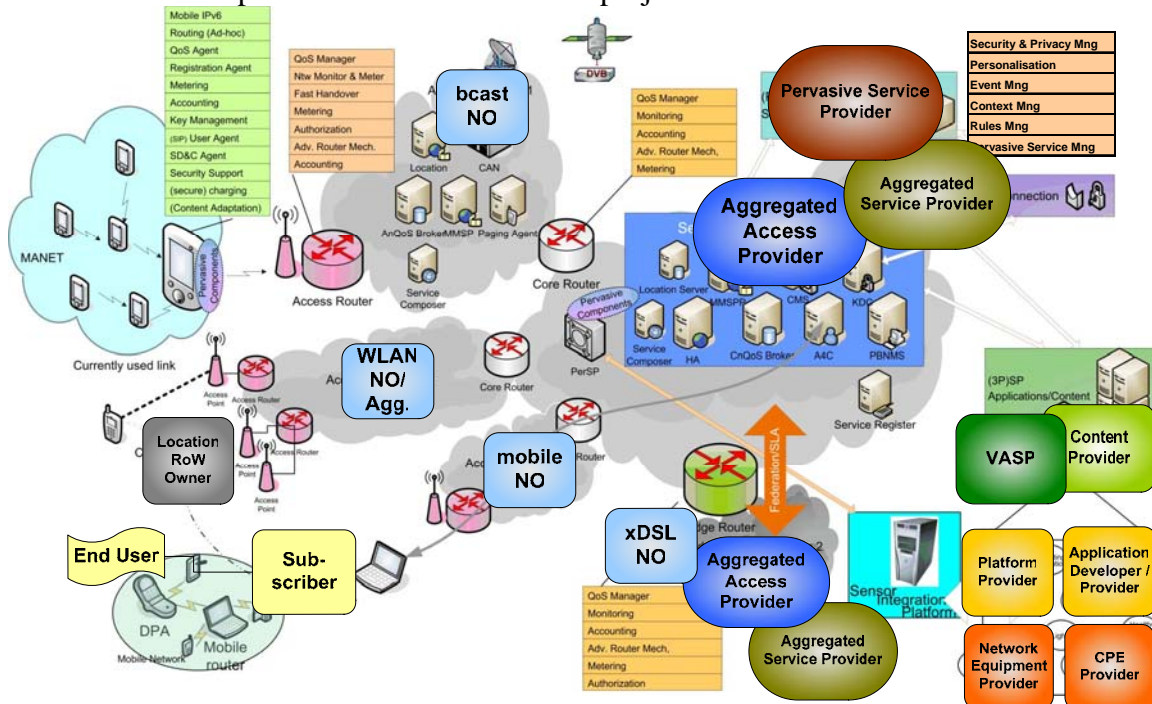


Figure 3 Value net of the converged B3G market and the DAIDALOS architecture

A market actor assuming the roles of Aggregated Service Provider and/or Pervasive Service Provider can act as a Trusted Third Party. Trusted Third Parties may prove the catalyst for the successful convergence of the telecommunications market by facilitating the impartiality and “fair play” amongst competing business actors, such as network operators or content providers, while leaving the customer relationship to the Service Providers. Next to commercial independence, system/application and middleware neutral implementation of solutions is important, together with clear rules for security and data confidentiality. But furthermore, they can provide a more financially solid model of converged services by centralising specific operations, while the cost is spread to multiple beneficiaries in the value web. Studies have already shown that this is the case for deploying QoS enabled network services [15], while the same can be argued for aggregated billing and virtual identity management.

5 Services Framework

The service model constitutes the basis for strategy planning for telecom operators as well as other types of businesses. To address the pervasive requirement for dynamic service-network interactions, services provided in the presented value net can be divided to:

- (DAIDALOS) Enabling Services (DESs). Functionality abstractions that are provided business-to-business in the complex value net as enablers to the provisioning of end-user pervasive services:
 - Pervasive DES (perDES). These are the enablers that add pervasiveness (Personalisation, Context, etc). These services reside in the higher layers of the DAIDALOS architecture.
 - Provisioning DES (proDES). These services are the basic network enablers, residing in the lower layers of the DAIDALOS architecture, including basic network functionalities provided at AN level (anDES) and more complex DESs residing at Service Provisioning Platform level (sppDES).
- Value Adding Services (VASs). Services that are visible to the user and that deliver content or value to that end user, or that may become part of a service chain that ultimately provides value to an end user.
 - perVAS. These are VASs that makes use of the pervasiveness provided by the Daidalos network. They may include hardware services such as printers or displays, or software services such as web or multimedia services.
 - mVAS. These are mobile VASs that do not use the pervasiveness of Daidalos, but will continue to be available to users on the Daidalos network.

The critical impact of the above categorisation of services is that network functionality which has been traditionally hosted and controlled by a single entity (the Operator / Service Provider) can now be used and thus traded separately, through an appropriate service discovery and composition scheme. Every business role within the presented value net is ultimately making use of one or more of the above service types. It is therefore important to provide a clear mapping of roles to services, which also defines the interdependencies between roles, illustrated in Figure 4.

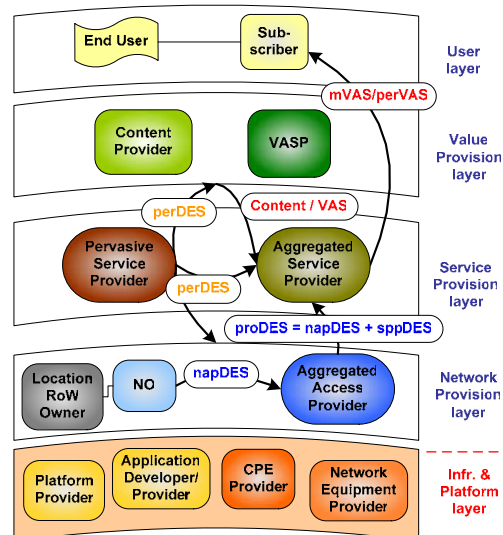


Figure 4: Services Framework

6 Business models for the evolved Operator

The most attractive business models based on the opportunities for the operator presented above are the following:

- The “traditional” vertical operator: in this model, the operator traditionally dominating all roles in the value chain maintains customer relationship, while opening-up to 3rd Party Value-Adding Service Providers (VASPs) in a “semi-walled garden” similar to current i-mode business model [16].
- The Aggregated Service Provider: the operator is concentrating to service aggregation, eventually including pervasiveness features, retaining customer ownership but working with 3rd Party Value-Adding Service Providers (VASPs) and access Network Operators based on revenue sharing models.
- The Aggregated Access Provider: in this model, the Operator converges (through self-development or business acquisitions) into a multi-standard operator while also aggregating 3rd party networks.
- The Trusted Third Party model: here the operator acquires the key roles of pervasive capabilities and network aggregation provider as a mediator. Both network operation and end-user service provisioning is left completely to 3rd Parties, in a credit-card like business model.

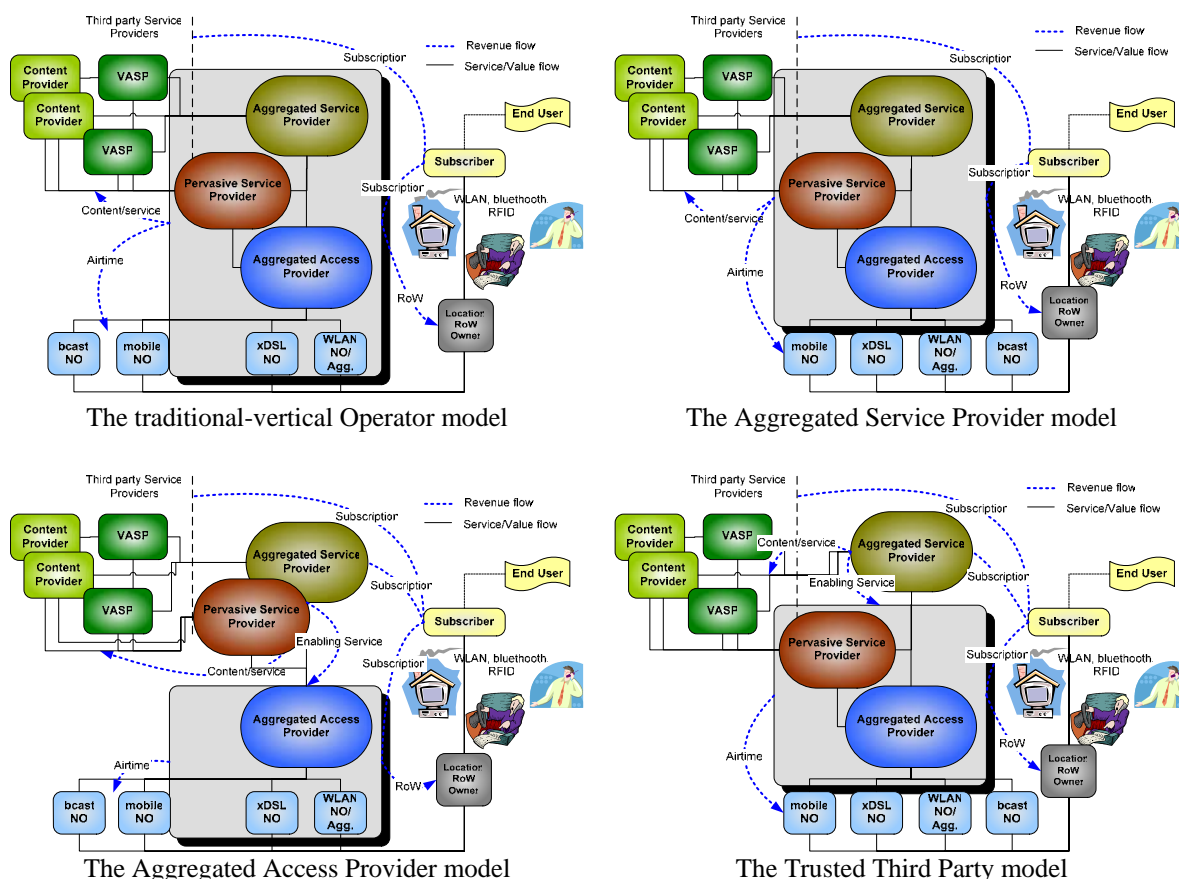


Figure 5 Business models for the evolved Operator

7 Conclusions & future work

The vision of pervasiveness is imposing a transposition of the centre of weight from the monolithic business domains of traditional “Network Operators” – acquiring the dominant role in service provision chains – to the concept of “Service Providers” value net who in

cooperation with a multitude of entities (including application & middleware providers, content providers, connectivity / network bearer providers) provide in a transparent way, a seamless pervasive experience to the end-user.

But the offering of pervasive services enabled by technologies such as developed in the DAIDALOS project present an important business opportunity for the Network Operators to rethink their business and re-evaluate their strategies, in order to gain back the competitive advantage they have lost in the converging telecommunications landscape, with cheaper service offerings and competing network technologies undermining the efficiency of traditional business models. The new business models presented in this paper indicate an advantageous position for the Operator to acquire key roles in the new value net and depending on its strategy shift more to the aggregated service provisioning, network aggregation or acting as a trusted third party.

Further work involves producing a more concrete evaluation of the business models proposed in this paper by building indicative business cases as described in phase 3 of the methodology. Based on the scenarios such as the one mentioned in the introduction of this paper, the business models introduced will be applied on specific markets in order to produce indicative financial analysis that will serve to evaluate the viability of the models.

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