

MVNO AN EFFICIENT ALTERNATIVE TO DEVELOP TELECOMMUNICATIONS SERVICES MARKET

TARGET

- Our goal is to understand how to create end-to-end telecommunications services with desirable and predictable properties, such as performance and reliability, when provisioned from multiple and independent service providers.
- Developing a new architecture for future telecommunications services that supports the dynamic confederation of sometimes collaborating and sometimes-competing service providers.
- Provides a resource management system based on predictive resource reservations, traffic-matrix admission control, and group policing for detecting malicious flows.
- The Proposed structure is focused on dynamic trunking decisions within and across ISP clouds. It offers a starting point for our investigation into the generalization of the concept of service level agreement to multiple service providers and for properties other than bandwidth, latency, and packet loss rates.
- It illustrates the principles of improved scalability and predictability through aggregation, and the use of hierarchy and cooperation among service providers to make effective and agile resource allocation decisions.
- It's possible to extending this work in the direction of more general application of economic mechanisms, such as dynamic auctions, for resource allocation problems in multi-provider telecommunications service architectures.

Motivation: The Existing Operator Model is Failing

The expense of deploying Third Generation (3G) Telecommunications Systems will be huge. The European auctions for 3G spectra are likely to exceed \$150 billion, with \$45 billion already committed in Germany and \$35 billion in the United Kingdom (U.K.). Equipment outlays are likely to match these spectrum expenses. And this is all before first revenue, without a clear understanding of the kinds of new services and applications enabled by 3G bandwidths for which subscribers will pay. Cheap (core) network bandwidth and the highly competitive environment brought about by widespread liberalization of the telecommunications sector is simultaneously driving bandwidth prices towards zero while yielding a financial crisis for the operators!

There is a growing recognition that highly integrated “all things to all people” telecommunications companies, like AT&T or British Telecomm (BT), on the one hand provide no effective economies of scale and on the other have encumbered very large debt in pursuing their integrated visions. A new, more functional specialization is being called for:

“The new rules for success will be to provide one part of the puzzle and to cooperate with other suppliers to create the complete solutions that customers require. ... [V]ertical integration breaks down when innovation speeds up. The big

telecoms firms that will win back investor confidence soonest will be those with the courage to rip apart their monolithic structure along functional layers, to swap size for speed and to embrace rather than fear disruptive technologies.”
[Economist 2000]

The Need: A New Service Model for a New Business Model ... Beyond the Third Generation

- We believe that a radically new service architecture is needed, and one that cannot be separated from an equally radical view of the telecommunications operator’s role in the new value chain of service provision. Simply stated, future telecommunications systems will be organized not as monolithic structures deployed by a single business entity, but rather as a dynamic confederation of multiple—sometimes cooperating and sometimes competing—service providers.
- We are investigating just such a service architecture, and deploying a prototype and evaluating it in a tested environment, on a building, campus, and potentially regional-scale, in collaboration with industrial partners. These partners include network equipment manufacturers as well as network operators.

Overarching Themes

- Diversity rather than homogeneity: Future telecommunications systems will be characterized by many kinds of end devices, access networks, services, applications, service providers and content providers. While common interfaces are highly desired, it is inevitable that not every participant will make use of even the most well developed standards. Therefore, the service architecture must embrace diversity and exploit software mediation to achieve interoperability.
- No overarching access network: A variety of access networks and data services will co-exist for some time to come. For example, in the wireless access network, we will have EDGE, HSCSD (high speed circuit switched data), GPRS (general packet radio service), 3G packet, and so on. The architecture must achieve application transparency by providing the necessary services to integrate these.
- Enable emerging business models: The service architecture must support technologies that enable new business models, such as Mobile Virtual Network Operator (MVNO) to achieve enhanced efficiency of resource usage.
- It’s all about services: The service architecture must enable business entities to provide enhanced services, as a primary means of differentiating one provider from another. Support for sophisticated capability negotiation and service level peering, and concepts like enhanced preferences management in support of the Virtual Home Environment (VHE), will be essential pieces of any such service architecture.
- It’s all about confederated services: The service architecture must support overlapping service provider regions, with subscribers able to roam among them for service provisioning, even without actually “moving.” The architecture must support “competition” among service providers, that is, sometimes cooperating and sometimes competing relationships, forming dynamic syndicates for the purpose of service provision.

- Network-application awareness: To better support subscribers in their tasks, the service architecture must provide mechanisms that make the network more aware of applications (e.g., near-term future indications of needed bandwidth), while the applications become more aware of the availability of system parameters and resources (e.g., user location, proximity of system resources to the user's current location, etc.).

The goal is to develop a revolutionary alternative architecture for future telecommunications systems, based on the following assumptions:

- Service providers will desire to form dynamic confederations to better share resources (spectrum, bandwidth, processing, storage, and infrastructure like antenna sites), and deploy access and achieve regional coverage more rapidly. While this runs counter to the way that most operators behave today, there is an emerging realisation that given the astronomical costs of building out the 3G networks, partnering to share the costs and the risks, or just to keep the network pipes filled, are driving operators in this direction. This is already happening in Europe, where some operators are forming partnerships to build a shared infrastructure for wireless access despite being competitors.
- Trusted third partners (e.g., Clearinghouses, Resource Brokers, B2B Exchanges, etc.) will manage the resource marketplace in a fair, unbiased, audited and verifiable basis. While agent architectures and multi-agent co-ordination are well researched areas, the details of the potentially very rich web of relationships among intermediaries needs to be structured and better understood in the specific context of resource negotiation between subscribers and service providers (and between the various layers of service providers).
- The traditional vertical stovepipe of access providers (frequency, cell site, base station, backhaul) will be replaced by a radically different organisation of horizontally organised "multi-providers," open to increased competition and more efficient allocation of resources. The same is true of access network, core network, service provider, and content provider. A key contribution of this research will be a better understanding of the needed technological support for such horizontal service organisation, through the design, prototype implementation, and system evaluation we will undertake.
- An open service and resource allocation model, with independent service creation, establishment, and placement in overlapping domains of service providers. Service providers must be able to advertise available slack resources, husband some resources for near-term peak needs, and be recharged for usage of resources by third parties. There is an open question of how much information about the current availability of resources should be made—as this would allow a competitor to understand the weaknesses of the advertising service provider.

- Provider resources, capabilities, and current status need to be described, and exchanged between confederated service providers, whether it is for the purposes of “reselling resources” where they are collocated, or for implementing VHE functionality through local provisioning. The nature of capability negotiation needs to be understood in this more complex, more heterogeneous environment than that found in conventional telephony networks.
- Allocation mechanisms based on economic methods, such as electronic auctions, coupled with real-time accounting/billing/settlement systems for the resources used. This in part solves the question raised in the first bullet above—if the intermediary “market maker” can hide the details of the state of the participating providers’ resource pools. This raises another issue: the desirability of peer-to-peer systems versus a centralized market mechanism that might serve as a potential single point of failure.
- Mechanisms for managing trust relationships among clients and service providers, and between service providers, based on trusted third party monitors. Existing interrelationships among service providers are based on contracts between large and well-established commercial enterprises. Such assumptions may not be suitable as the number and scope of service providers increase dramatically. Trusted third parties might audit the behaviour of service providers, a kind of “better business bureau,” providing a rating service that separates the reliable participants from those who are unreliable.
- General services for forming dynamic confederations, such as: discovering potential confederates, establishing trust relationships, managing transitive trust relationships (if A trusts B and B trusts C, what can you infer about the relationship between A and C?) and managing the levels of transparency (e.g., reveal aspects of internal information to peers or trusted third parties about performance, user information, etc.).
- Not all confederates need be potential competitors. Confederations can be formed of heterogeneous, collocated access networks to better support a given subscriber’s application needs. For example, a WLAN operator (i.e., an enterprise) may confederate with a cellular network provider to provide two separate pipes for high bandwidth data and low bandwidth voice streams in support of a user’s multimedia conferencing application. We assume that the user carries both a cell phone and some kind of screen-oriented computing device, and that these devices have now formed a confederation to transparently support an application, with the audio coming over the phone and the images over the WLAN. Similarly, the relationship between an enterprise level GSM on the Net (GoN) operator and the overlay cellular operator is an example of a non-competitive confederation.