Migration from Traditional Networks to Converged Next Generation Networks Architecture with Guaranteed Quality of Service

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Abstract

The development of more powerful communication systems, such as NGN networks, will soon make traditional communication systems obsolete. Instead of wasting these expensive and functional resources, it is more economical to explore ways of transforming them into sophisticated NGN-compatible architectures. This can be achieved through a suitably designed migration process from vertical networks with separate services to horizontal multiservice converged networks. However, different operators have different needs and objectives when undertaking this all-important migration process. In this work, we propose a migration strategy, which takes several factors into consideration. In particular, the proposed migration strategy aims for assisting established operators to capitalize on their existing resources and migrate smoothly towards converged NGN architecture. Most importantly, the desired upgrade is achieved while satisfying requirements in terms of QoS guarantees.

Index terms *- NGN QoS, converged transport and control framework, NGN Migration, IP/MPLS.*

1. Introduction

Next Generation Networks (NGN) is no longer a future issue but will soon become the state of the art for many telecommunication networks. Once NGN are in service, most traditional communication networks will become obsolete as they are. Instead of wasting this huge volume of traditional networks, it is more efficient to devise ways to transform them into NGN-compatible systems so that they continue to be functional and viable. Besides, one of the main issues related to NGNs, which has been the focus of several works and still require further research and development, is the end-to-end QoS guarantee. For instance, the NGN QoS signaling and control solutions are still at the development stages. PacketCable, proposed a QoS solution, as outlined in [1], which focuses mainly on some precise problems related to packet-based cable access networks. Similarly, the 3GPP also proposed an end-to-end QoS solution for the 3rd generation mobile networks, as described in [2]. It was developed for specific category of networks and lacks several functionalities that can be deemed necessary for a standard NGN QoS model. Based on previous works, as in [3, 4, 5 and 6], in this work we propose an alternative NGN migration strategy which details the technical steps and decisions making required in upgrading a traditional communication network into one that is similar or equivalent to an NGN network. The proposed migration strategy takes further factors into considerations and provides desired improvements in order to satisfy requirements in terms of QoS. In addition to what has been suggested in previous works, our proposed migration strategy integrates new entities for guaranteeing QoS. In particular, the call management and gate control functionalities are sub-divided into Call Server (CS) and Resource and Admission Control Manager (RACM). This subdivision allows for the application of call admission control (CAC), achieving reliable and accurate resource management and improving the transport network scalability and resilience. The RACM is further decomposed into distinct Service Policy Decision Manager (SPDM) and Transport Resource Control Manager (TRCM) entities in order to enable the coverage of large domains. Finally, the necessary interfaces are defined and the corresponding open and mature standards are specified.

The organization of this paper follows a standard methodology of development in five sections. The first section describes the target architecture. The choice of transport technology is outlined in second section. The third section is dedicated to the established operators versus new operator migrations. In the fourth section, the migration of the traditional and connection-oriented telecoms networks is described. The fifth section clarifies the QoS guaranteeing. Summary and concluding remarks are presented in the last section.

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2. Target architecture

The proposed migration strategy is a multi-dimensional problem based on several parameters and variables, which depend on the actors' activities and positioning. Notably, beyond the separation between "telecommunications" or "data" origin domains, we can distinguish between different interests depending on whether the actor is mainly positioned in the low (transport), middle (control) or high (service) layers. One of the fundamental questions encountered by operators deals with the choice of the technology and the migration strategy decision-making process. In this work, we develop a migration strategy, which helps new and former operators to converge classic and new wide-band services, on the same network. The target network structure shall be based on a unique packet-switched core network for all types of access networks, services and terminals. Also, the network architecture shall be separated in layers (Transport, Control and Service). These layers shall interact via open and normalized interfaces in order to develop network-independent services. Finally, the proposed network shall support in total mobility, real-time multimedia applications, be adaptable to multiple user terminals and able to access network capacities. As illustrated in Figure 1, the resulting architecture was designed for large-scale networks with multiple domains. It addresses different QoS requirements of multiservice high load traffic generated by various types of users.

3. Transport technology choice

The NGN methodology and concept are based on packet switching technology, which offers high network resource availability. Different transport technologies have been discussed as candidates for integrating the transport layer. Asynchronous Transfer Mode (ATM) is one such proposed technology solution. ATM provides evolved Traffic Engineering (TE) to multiple services with a broad range of requirements using a unified infrastructure based on packet switching. Despite its potential, ATM failed to become the technology of choice for service integration, due to several reasons. Perhaps, the lack of native ATM services is the main reason why ATM was not widely adopted by operators as a unique transport technology.

Presently, most deployed infrastructures use IP transport technology and related protocols, which require the use of IP as agent for transport unified infrastructure in NGN. Inherently, an IP lacks the TE mechanisms capable of offering a differentiated QoS, while efficiently allocating the network resource. On the other hand, MPLS offers a straightforward way of incorporating such TE mechanisms into IP, enabling evolved network engineering. The Label Switched Paths (LSP) and tunnels are virtual connections, offering bandwidth (BW) to services, according to the traffic contract describing the predefined QoS classes [7]. The integration of DiffServ with MPLS guarantees the QoS for a broad range of multiservice traffic. Particular traffic control and engineering mechanisms are defined in order to guarantee the appropriate treatment for packets belonging to each service class. They control the ingress traffic compliance and guarantee the specified QoS. Indeed, the choice of DiffServ and MPLS integration QoS mechanisms improves the QoS and offers traffic policy and classification in diverse QoS classes of the transport data plane. This offers scalability, reliability and high performance and forces operators to use existing mature protocols. Moreover, any short-term evolution towards GMPLS based-solution will be feasible. This simplifies the transport network management. Besides, this choice of technology and resulting migration strategy may be driven by other factors. These include; the offered services and the customer needs, the existing infrastructure status, the diverse categories of operators, the revenues generated by different traffic, the operator development plans, and whether the operator is new or old. Accordingly, in this work, we decided that our migration strategy will be based on an IP/MPLS transport technology and consisted of the migration of traditional and connection-oriented telecoms networks, of which the telephony and connection-oriented data traffic represent a large part of their total traffic.

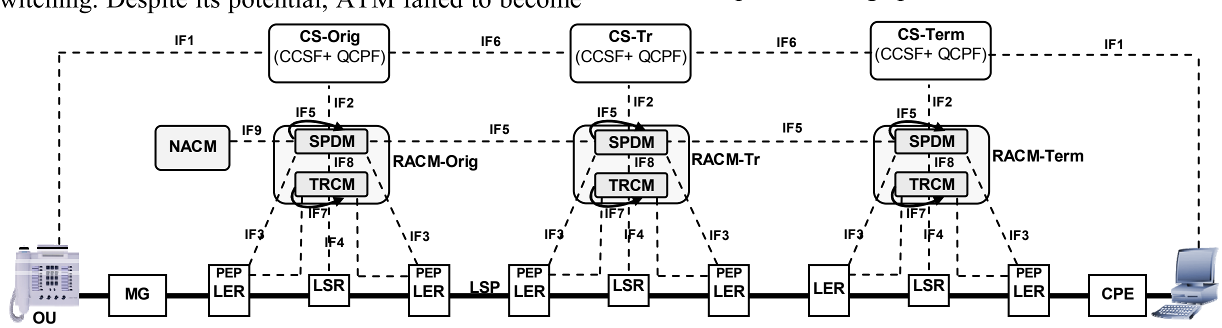

Figure 1. Guaranteed QoS-NGN target architecture

4. Established versus new operators

The approach for established operators can be achieved through a long-term progressive and incremental methodology. The existing large customer database (DB) and highly extended networks which required extensive time and resources to develop and implement, may push operators to wait for the natural atrophy of their network equipments. Otherwise, the inter-operator competition, the needs in wide-band services, the existing network state and the arrival of new operators would press these existing operators to initiate their systems' migrations in order to offer new evolved services. However, new operators do not have to implement a migration strategy since they can opt directly for an NGN solution, which combines voice, data and video services. This choice is identified as a necessity for new operators to ensure competitiveness in their technical, operational and commercial plans.

5. Migration of traditional and connection-oriented telecoms networks

One of the problems associated with the use of circuit-switched networks lies in the fact that they are not optimized for data traffic transport. The exponential increase of the Internet traffic through public networks adds a supplementary load. One way to deal with this overload is to use a packet-switched multiservice network, which offers a large BW gain, facilitates the voice and data flow services and decreases the OPEX. Operators tend to aim for maximizing the use of their available and fully functioning network resources instead of acquiring new alternative technologies. Also, during any planned migration process, operators are required to guarantee the continuity of their services in order to serve their subscribers' needs. Therefore, it is necessary to develop an efficient migration strategy, which guides operators through modernizing their networks toward NGN architecture with guaranteed QoS.

5.1. Circuit-switched network consolidation

The main objective of this step consists of improving the treatment and switching capacity and increasing the transport network performance by consolidating the circuit-switched infrastructures. This step reduces the operator's capital expenditure (CAPEX) and operational expenditure (OPEX). Practically, this may be realized by the integration of new high-speed packet-based interfaces in the existing transit exchanges, which permit the conversion of voice traffic from the circuit-switching mode to packet-switching mode. This step can be combined with the integration of new packet switching entities which prepare for the migration.

5.1.1. Transit network consolidation: The consolidation of the transit network and the migration toward the NGN architecture may offer several advantages for an established operator. Optimized gain in bandwidth and improvements in term of services as well as QoS are among these advantages. To start, it is necessary to discourage any new investments in circuit switching equipments, except in cases of extreme necessity (inexistence of equivalent NGN equipments). The deployment of new packet-switching nodes and the integration of high packet-switching interfaces in the existing nodes permit a fast integration of new services and ensure the transport of voice traffic in packet-switching mode. The integration of packet-switching technologies within the existing equipments reduces the OPEX through reusing existing infrastructure to suppress circuit-switching traffic growth in order to relieve the Transit Exchanges (TEX).

5.1.2. Access networks' consolidation: During this first stage of the migration the Local Exchanges (LEX) remain intact, with existing subscriber systems connected. Integrating new packet-switching based Access Nodes (ANs) and upgrading existing ones capitalizes on existing equipments, while extending the packet-switched coverage area to end users. This new access technology provides seamless multiservice access to voice (POTS, ISDN) and data (xDSL, ATM, IP, FR, etc.) services and paves the way to NGN structure. Also, new access equipments can be installed using xDSL technology which enables ADSL and SHDSL in addition to ordinary PSTN and ISDN services. The optimization of the xDSL access infrastructure is realized through the introduction of voice over DSL services using the V5.2 interface connection to the LEX. Accordingly, a multiservice network can be expanded to the end user's desk, providing voice and high speed Internet access over a single copper line. This reduces the OPEX and offers new packet-based services. For new subscribers, they shall be served and connected directly on the packet-switched transport network via ANs, Integrated Access Device (IAD) and other connecting equipments.

5.1.3. Intelligent network (IN) consolidation: For the purpose of using some existing IN services in future NGN architectures it is necessary to consolidate these networks. This may be realized through the adaptation of the Service Control Point (SCP) with new protocols so that it can communicate thereafter with the NGN and the web servers and integrate voice and data services in shared applications. Several versions of IN service-compatible protocols have been defined in order to integrate the IN services with new packet-based web services, such as PINT and SPIRITS [5].

5.1.4. New packet-switching services: For the purpose of preparing for the NGN migration and implementing the service layer, the operator shall start with the implementation of an environment for the development of packet-based services. For the same objective, it is necessary to deploy application servers based on open and normalized interfaces as well as on an object-oriented (OO) platform, which offers a flexibility and speed in the development of services.

5.2. Transit layer migration

For the telecoms and connection-oriented data traffic operators that have parts composed of PSTN, ISDN, IN, ATM, FR, etc., we decided to apply the NGN concept in the transit level, from the beginning. That is, use a packet-based transit layer for the transport of different traffic. This choice results in reduction of the OPEX and relief of the existing circuit-switched transit level of the voice traffic transport load. This also exploits the packet switching advantages in terms of optimal resource allocation, including BW gain and provision, dimensioning flexibility and evolved service creation. We also decided to choose IP/MPLS as the transport technology, which offers high performance, scalability and flexibility in the transit level. The connection of different access networks is ensured via the Access Gateway (AG), Media Gateway (MG) and Multiservice Gateway (MSG). The latter, is equipped with multiple interfaces that guarantee a simultaneous migration of different access networks. The transport of the voice traffic may be accomplished through the IP/MPLS transport layer, which preserves a high level QoS, [7] compared to the TDM networks. Practically, for the multi-domain networks, the migration may start with the domain, which carries the highest traffic load.

5.2.1. Introduction of CS and MG to the control and transit levels: The transit layer migration starts with the implementation of the IP/MPLS protocols in order to improve the performance of the transport network in terms of traffic engineering and routing, as well as integrate certain AG, MG, SG and MSG components. These entities ensure the connection, conversion and transmission, under the control of the CS, of various flows generated by different access networks towards the packet-switched transit network. A per domain new CS shall also be implemented in the control level. The Call Control and Signaling Function (CCSF) and the QoS Control and Policy Function (QCPF) represent the main functions offered by this entity. It identifies the originating and terminating connection points in the network and interacts with other CS, MG, MSG, and end-user terminals by means of signaling protocols. It can play the role of a Service Switching Point (SSP) and offer the ISUP and INAP signaling interfaces in order to reach the IN, PSTN and ISDN services. In practice, the number of required CS may depend of the number of used MGs. A network redundancy can also be implemented by using multiple CS to serve large domains. This CS redundancy shares the total traffic load and avoids total failure situations. All these steps ensure the voice traffic transport in packet-switching mode and avoid the congestion and call blocking problems existing in the circuit-switched networks.

5.2.2. Introduction of the RACMs for QoS guaranteeing: In this step, it is necessary to start establishing the QoS guarantee procedures and performing the corresponding rules. Thus, we integrate new entities for QoS guaranteeing by splitting the call management and gate control functionalities into CS and RACM. This ensures CAC, achieves reliable and accurate resource management and improves the transport network scalability and resilience. We also decompose the RACM into distinct SPDM and TRCM entities in order to enable the coverage of large domains.

The use of the RACM architecture guarantees the required QoS for carrying the multiservice traffic on an NGN network. In accordance with the NGN concept, this component separates the call control functions from the specific transport functions. It ensures the authorization, reservation, commitment and release of the network resources as well as the CAC and the QoS guarantee. Practically, it consists of two functional entities: the *SPDM* and the *TRCM*. This decomposition scales the reservation request load and offers a better scalability and robustness and enables the coverage of large network domains. Here, we suppose that a RACM may cover a domain, a TRCM may cover a sub domain and an NGN network may cover multiple domains.

The SPDM: consists of technology-independent transport, provides a single contact point and hides the transport network details from the CS. It makes the final decision regarding the network resource and admission control. It also maps the service QoS parameters and priority received from the CS to network QoS parameters and classes based on the network policy rules. The SPDM controls gates in the Policy Enforcement Points (PEP) at per flow basis and installs the appropriate policies to control flows. It also requests the TRCM instances to determine the necessary QoS resource along the media flow path.

The TRCM: consists of technology-dependent transport, provides the resource-based admission control decisions to the SPDM. It maps the network QoS parameters and classes received from the SPDM to transport QoS parameters and classes based on the transport policy rules. Each TRCM establishes aggregated physical paths for supporting the requested QoS between end points in its sub domain, maintains the network topology and keeps tracks of the transport resource occupation status.

In practice, the RACM may be deployed in different structures in order to provide high performance, scalability and resilience to large network domains. Firstly, as represented in Fig. 2, it can be implemented in a *hierarchical architecture.* In this case, a SPDM instance may interact with multiple TRCM instances and a TRCM instance may interact with multiple SPDM instances to satisfy the QoS resource requirements from edge to edge in the involved domain. The TRCMs receive reservation requests from SPDMs and apply resource reservation and allocation control to sub domains based on resource availability states. They interact with the SPDMs in order to share the domain resources and reserve bandwidth aggregations. The SPDM ensures the CAC based on the resource occupation state received from the TRCMs.

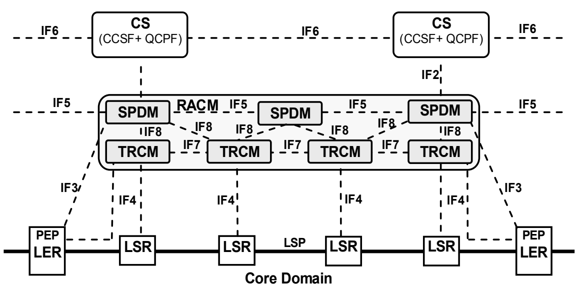

Figure 2. Hierarchical architecture

Secondly, as depicted in Fig. 3, it can also be designed in a *peering architecture*. In this case, the SPDMs and the peering TRCMs are implemented in the borders and the core domains, respectively. The SPDM may communicate on equal terms with the SPDMs of adjacent domains and with the first TRCM of the peering TRCMs of its domain. It identifies the TRCMs of the adjacent sub domains that the session crosses. The first TRCM instance interacts with its neighbouring TRCMs to determine the requested edge to edge QoS resource in the involved domain. They assign bandwidth aggregations along the adjacent sub domains.

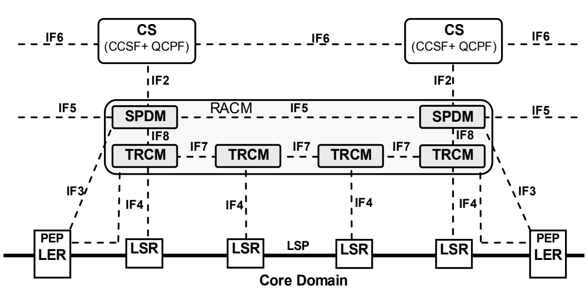

Figure 3. Peering architecture

Since a domain may have multiple sub-domains, for the two architectures, a TRCM shall be implemented for the control of each sub-domain. At the same time, the SPDM shall also be used for controlling the multiple TRCM instances in order to satisfy the QoS requirements in the involved domain.

5.2.3. Network Attachment control Manager (NACM): This step consists of implementing and configuring the NACM and establishing its connection with the SPDM. This component includes the network access registration, authentication, authorization and configuration parameters. It manages the IP address space of the access network and ensures a dynamic provision and allocation of the IP addresses (DHCP mode). The NACM controls the user location management, announces the contact point to the UE and initializes it for accessing the NGN services [8].

5.2.4. Traffic aggregation in the transit level: During this phase, the local exchanges remain intact, with their existing functional systems connected and subscriber DB unchanged. The operator shall start the conversion of the existing transit exchanges. The objective of this operation is to obtain new NGN equivalent equipments for controlling and connecting access networks and converting and carrying aggregated traffic. This approach protects the operator's previous investments and aggregates voice and data traffic on the same packet-based transit network. The operator should also purchase new access and transit nodes. These entities will be practically implemented in a distributed way at the border of the IP/MPLS transport network in order to provide aggregated connection of different access networks and ensure inter-operators exchanges. They also must support the basic PSTN and ISDN services as well as the xDSL and wide-band services. The IP access networks may be connected directly to the LER.

5.2.5. Signaling in packet-switching mode: One of the main objectives of the migration towards NGN is the transport of the signaling and users' traffic on the same packet-switched network. It is possible to either carry the signaling associated via the transport bearer or quasi-associated via the Signaling Gateway (SG). According to the SIGTRAN with SCTP protocols as defined in [9], in the quasi-associated way, the SS7 signaling may be carried over IP packet switching. The SG converts the SS7 signaling into IP packets and routes them to the CS. In the associated mode, the SS7 signaling messages are received by the MG, which encapsulates them in IP packets and forwards them transparently to the CS via the transport network.

5.2.6. Service layer implementation: In order to provide new wide-band services and meet the subscribers' needs, it is necessary to set up the service layer. Therefore, at this stage, the operator shall implement this layer in the new architecture by setting up the service and application servers' environments. Reliable, flexible and secured interaction between this new layer and the control layer based on open and normalized interfaces must be ensured. Besides, by offering an interface to the IN Systems via the INAP signaling protocol, the CS plays the role of a Service Switching Point (SSP) and enables efficient access to the IN-based services. This access may also be achieved through the nearest Signaling Gateway (SG), which routes the call towards the IN, under the CS control.

5.3. Access layer migration

When the CSs and the MGs are implemented in the control and transport layers; it becomes easy to spread the packet-switched coverage to the access level. This phase is generally completed at the second stage after the completion of the transit network migration. It requires sufficient capacity of the Call Server (CS) to store and manage the subscribers' profiles.

During the migration of the access layer, supplementary MGs and Access Nodes (ANs) may be implemented on the boundary of the transit network. These nodes permit the connection of different access networks such as the PSTN, ISDN, xDSL, IP, ATM, FR, etc. The implementation of the existing subscriber Databases (DB) may be also processed in this stage. If the operator needs to implement a new packet-switched access network or convert an existing access into packet-switching mode, the Gigabit Ethernet may be the most appropriate technology. It offers wide-band access, Virtual Private Networks (VPN), packet switching until the end-users, low latency delay with lower fees and mature products.

For the physical medium, fiber-optic, copper and coaxial cables are widely used in access networks.

5.3.1. Access networks' connection and new regions' coverage: For the public and private access networks, the PBX as well as the ATM or FR integrated access devices, may be connected directly to the transport network via Access Gateways (AGs) and MGs implemented on the boundary of the transport network. For the IP based access networks, the IP/MPLS carries this traffic appropriately between different domains. This offers the use of IP-VPN inter-enterprises. The ADSL subscribers may install RG or IAD that support voice over packet-coding capability, for carrying voice traffic in broadband packet switching. Alternatively, to update the end user's Customer Premises Equipment (CPE), the operator can choose to extend the DSLAM functionalities with an AG, which provides voice over packet gateway functionality. Besides, when there is a need to extend the packet-based wide-band services to cover new regions, additional packet-switched multiservice accesses may be implemented to service these new regions. As it has been specified previously, for the implementation of new access, the Gigabit Ethernet can be the technique of choice.

5.3.2. Traffic aggregation in the access level: With the deployment of wide-band access networks, the operators may carry aggregated voice and data traffic in packet-switching mode from the access level. This offers a best BW gain and captures the vertiginous growth of different access traffic. Some multiservice access equipments, Residential Gateway (RG) and Integrated Access Device (IAD) may be lodged on the boundaries of the transport network as well as at the end users' premises. This facilitates the supplying of new packet-based multimedia and wide-band services.

5.3.3. Subscribers directly serviced by the CS: The CS may directly connect and service terminals (e.g. SIP-terminal) by means of appropriate signaling protocols which merge voice, Internet access and multimedia services. Two standards: H.323 and SIP are defined for this purpose. The first is normalized by the ITU, which describes the procedures for point-to-point or point-to-multipoint real time audio and video communications over IP networks. The second is normalized by the IETF. It is a signaling protocol used for the establishment of real-time multimedia sessions, and calls and video-conferencing between two or several subscribers on IP packet-based networks. Customers of multimedia services rely heavily on these protocols.

5.4. Introduction of wide-band services

The network evolution in the transport and control levels creates the opportunity for the invention of new services. Wide-band access networks, packet-based transport level, new multimedia terminals, and convergence between transport and control layers offer flexibility in the development of new interactive and adaptable wide-band and multimedia services. This service diversity may be used in full mobility and portability on different terminals and in unicast, multicast and broadcast modes. Also, this evolution provides customers access to service platforms via a packet-switched unified transport network, regardless of the used protocols or terminals.

5.4.1. Wide-band services: In order to create new adaptable and portable multimedia services in full mobility, it is necessary to employ new call control protocols such as SIP or H.323, new architectures and open and normalized interfaces (API). Otherwise, the NGN entities' treatment capacities, the BW availability, the resources and admission control management, and traffic control and engineering mechanisms may offer more efficiency and importance to the multimedia services. This improves the end users' communication capabilities beyond classical services. The use of IP/MPLS technology in the transport level provides combined wide-band and classical services with guaranteed QoS. New operators and service providers shall offer high-speed Internet and video service bundle and look to provide PSTN voice service replacement. The need for voice service support is driven by the fact that these services offer excellent margin and return on investment. Finally, this gradual evolution towards multimedia and wide-band services is also based on the progress of the control protocols, users' terminals and development platforms.

5.4.2. Evolution of users' terminals: The deployment of wide-band and multimedia services requires the availability of suitable terminals. These terminals shall instigate a service request and ask for the establishment of end-to-end calls, multimedia sessions and video-conferencing. They shall also support at service setup, a QoS negotiation capability at either the control or the transport level and in push or pull mode.

5.4.3. Open and normalized Interfaces: The NGN architecture separates the service, control and transport layers and defines open and normalized Application Programming Interfaces for interaction between them. Moreover, it uses normalized protocols for connecting its entities. These interfaces normalize the inter-layer interactions and facilitate the invention of new services.

5.5. Conversion of TDM equipments:

As a last step of the migration toward NGN, the TDM equipments may be transformed into or definitively replaced by adequate NGN equipments. This migration is driven mainly by the imminent obsoleteness of the installed narrow-band switches. Depending on the type of the used equipment, the migration of existing facilities to NGN equivalent equipments may be achieved in different ways. Firstly, new NGN facilities are developed and existing obsolete narrow-band switches are progressively replaced. The replaced entities may be deployed at the extension of the access layer for traffic concentrations. Secondly, it may also be achieved through the conversion of the existing entities. This is obtained by a physical decomposition of the monolithic block in different network layers. Schematically, the call control and treatment intelligence resources will be dissociated from the connection and switching interfaces in order to obtain new NGN equivalent entities. Thirdly, this conversion may be accomplished in a physical manner by the integration of new wide-band packet-switching interfaces within these switches or finally by a logical conversion to implement new NGN functionalities.

5.6. Detailed view of the core network

A core network is a packet-based IP/MPLS technology, which offers a better QoS guarantee, BW gain and traffic control and engineering. It interacts with access and other transit networks via the MG, AG and TG. For the operators, which have a native ATM technology in their transport network, may start with a combination of ATM and MPLS technologies. Through simple adaptation, MPLS may use ATM's existing cell-switching capabilities and new high-speed packet forwarding techniques. This consists of installing MPLS protocol over the ATM switches, so-called "IP-aware" and develops the knowledge of the IP topology by means of a routing protocol. These switches are called ATM-LSR. A migration thereafter towards the IP/MPLS architecture can easily be achieved. This migration shall largely exploit the existing infrastructure without disturbing the functional systems [10]. The transmission network may be based on WDM or TDM multiplexing. The latter can be achieved via the use of the hierarchy SDH or the technology Packet over SDH (PoS). This offers high-speed and large-band traffic carrying for long distances. For the physical medium, fiber-optic supports are already extensively used in the existing transport networks.

5.7. Communication interfaces

One of the key elements is the definition of the interfaces and the corresponding protocols between different functional entities. In this work, we consider each interface indicated in the architecture defined in Fig. 1, and identify the appropriate protocol for it. The intra domain *IF1 interface* exists between the calling user and the CS. It is used for the call signaling establishment and the transport of the QoS control messages. SIP is considered as the appropriate protocol for this interface. The intra domain *IF2 interface* exists between the CS and the RACM and is used to perform the call control functions. There are several protocols that can be suitable for this interface such as: SIP, COPS and NRCP. The intra domain *IF3 interface*, which firmly depends on the transport technologies (IP/MPLS), is used by the SPDM for controlling the PEPs and performing rulers on a per call basis. The mature protocols for this interface are: H.248 and

COPS. The intra domain *IF4 interface* is implemented between the LSR and the TRCM. It is used for the control of functional entities in the IP/MPLS core network. The selected protocol for this interface shall depend firmly on the IP/MPLS transport technologies. Based on this constraint, the H.248 protocol becomes the suitable protocol for this interface, since it supports MPLS packages for label stack imposition and NAT traversal as well as mechanisms for traffic management and conditioning and failure recovery [11]. The inter domain *IF5 interface* which links the RACMs (inter SPDMs), is necessary when two or more RACMs need to interact directly without the CS control in order to determine the QoS resource along the call path. Since IF5 and IF2 interfaces have similar functionalities, we decided to select for IF5 the same protocols defined for IF2. The inter domain *IF6 interface* exists between CSs. It ensures peer-to-peer call control and signaling exchanges. The appropriate protocol for this interface is SIP. The intra domain *IF7 interface* binds the TRCMs in order to determine the requested QoS resources inside large domains. Because of the majority of functionalities provided by IF7 are similar to those of IF2, the same protocols defined for IF2 was chosen for this interface. The intra domain *IF8 interface* provides interaction between the SPDM and the TRCM to determine the requested QoS resource reservation in the involved core domain along the media flow path. Since, the IF8 and IF2 have similar functionalities, the same protocols defined for IF2 was implemented for this interface as well. The intra domain *IF9 interface* provides interaction between the SPDM and the NACM for checking on the transport subscription and information binding. A convenient protocol for this interface is Diameter.

6. QoS guarantee

The QoS guarantee in this migration strategy was evoked in many levels. It may be ensured by the use of:

1. The IP/MPLS in the transport level, which offers a better TE and resource control and management.
2. The DiffServ with MPLS integration, which guarantees the QoS according to the defined CoS and offers traffic policy and classification as well as scalability, reliability and high performance in the transport data plane.
3. Standard and normalized control and signaling protocols as well as a transport and transmission networks based on high performance techniques and technologies.
4. The packet-switched core network, which offers better bandwidth gain.
5. The Call Server which controls the network entities and participates in the QoS control and guarantee.
6. The RACM, which ensures the resource control and management, the QoS control and adjustment, the resource-based admission control and the resource reservation and provision for sessions.

7. Conclusion

In this work, we proposed a migration strategy, which depends essentially on several factors, including: the offered services and the customer needs, the existing infrastructure status and the type of the operator, the revenues generated by different traffic, the operator development plans, and whether the operator is new or old. The new NGN architecture permits the extension of traditional network capacities in order to support new wide-band and high-speed service *bundle. The proposed* migration strategy was specifically designed for helping established operators to capitalize on their existing resources and migrate smoothly towards the NGN architecture. In addition, the IP/MPLS technology in the transport level in order to guarantee the QoS and exploit existing infrastructures. This choice is essentially driven by the availability of networks and services as well as the customers' needs and the operators' rights.

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