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MOBILE NETWORKS MIGRATION TOWARDS NGN

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ABSTRACT

One of the challenging tasks of an established mobile network operator in migration to NGN structures is complete the 2G network migration to UMTS R4 architecture. The present article concerns the mobile network migration towards the NGN .Our contribution consists of three parts. At first, we studied the existing network architecture and the 2G TMSC equipment to migrate as well as its various features. Afterward we proposed a migration scenario adapted to the various network constraints and which answer the need of the operator. Finally we realized a dimensioning study to determine the number of necessary equipments in the process of migration.

Keywords: *Next Generation Network (NGN), Universal Mobile Telecommunications System (UMTS), Second generation (2G), transit Mobile Switching Center (TMSC)*

1. INTRODUCTION

The need for the user as regards sophisticated applications and multimedia services and the need for the mobile operators to increase their incomes in order to remain competitive in an environment characterized by an increased competition, are the reasons which pushed Telecom operators to position their activities on the IP networks and to adopt new NGN (Next Generation Network) structures[1] .

This prospect can be realized only through a preliminary stage consisting in migrating their mobile network 2G to the architecture UMTS (Universal Mobile Telecommunications System) Release 4 [2].

For an established operator, the evolution of its existing 2G network towards new 3G R4 architecture will require a progressive migration strategy consisting in dived the migration project in 2 big phases:

1st phase: swapping all the existing 2G MSC (Mobile Switching Center) equipments towards new 3G MSS (Mobile Switching Server) and MGW(Media Gateway) equipments.

2nd phase: swapping the number of 2G TMSC (Transit Mobile Switching Center) remaining equipments towards new 3G MSS and MGW equipments. [1, 4]

However, whether it is in the first or in the second phase, the implementation of a migration solution is confronted with numerous problematic which can be counted in 2 big ones:

1st problematic: which migration scenario is the most suitable to answer this need?

2nd problematic: which dimensioning approach to adopt to insure this migration?

The work realized within the framework of this article concerns the 2nd phase of the swap project consisting in replacing the number of 2G TMSC equipments by the new equipments 3G MSS and MGW, so, and to answer problems quoted above, we firstly proposed a solution of migration which meet perfectly the need of the operator, then we implemented a dimensioning approach to determine the number of necessary equipments in the process of migration.

This article articulates around four sections, the first section will present a state of the art of the existing mobile network architecture. In the second section, we will present the targeted architecture. the third section will develop our migration solution. the section 4 will describe our experimental results.

In conclusion, we will summarize the contributions of our works and the perspectives of this article.

2. SURVEY

In this section, we present our experimental network architecture as well as the element to migrate and its various features.

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A. The existing network architecture

The TDM (Time Division Multiplexing) technology used previously in the 2G network of the operator presented several limitations in term of wasting in bandwidth[3], for it the evolution towards a packet switched core network seems to be a necessity for the operator, if he wants to stay on the market and to increase its incomes. Therefore, the operator needs to realize the SWAP project which consists in replacing 2G existing MSC and TMSC equipments in the mobile network, towards 3G MSS / MGW equipments to migrate to the mobile generation UMTS Release 4.
The core existing network of the operator contains besides MSS and MGW elements implemented during the first phase of the Swap project, six 2G TMSC equipment. The following figure shows the existing operator's architecture .

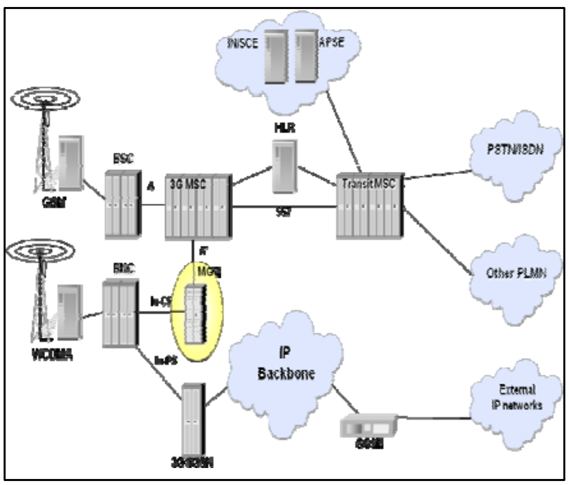

Figure1: existing operator's architecture

B. TMSC and its various features

The TMSC element (Transit Mobile Switching Center) is a transit switch serving to interconnect all the core network of the operator with the foreign networks as well with platforms (VMS, RBT and IVR).
This transit switch optimizes not only the signalling in the network but also works as an intelligent gateway from fixed networks to the GSM network. The Transit MSC simplifies the task to configure a big network containing many connected switching elements, as the MSC and the HLR(Home location Register). By forwarding all the signalling between the equipments by the Transit MSC, the operator is capable of streamlining the progress of signalling and of reducing the time and the money spent in the configuration of new elements in the network.

The TMSC serves to unload the MSC by taking some of their tasks as Voice E-mail Traffic, Transit Traffic. He also allows the functioning with the other networks as the ISDN (Integrated Services Digital Network) [5,9] networks and with the other platforms (IVR: Interactive Voice Response, RBT: Ring back Tone) The TMSC also plays the role of SMS-GMSC by transmitting the short messages from the MSC towards the center of SMS[9].
The figure 2 shows the various interconnections of TMSC equipment.

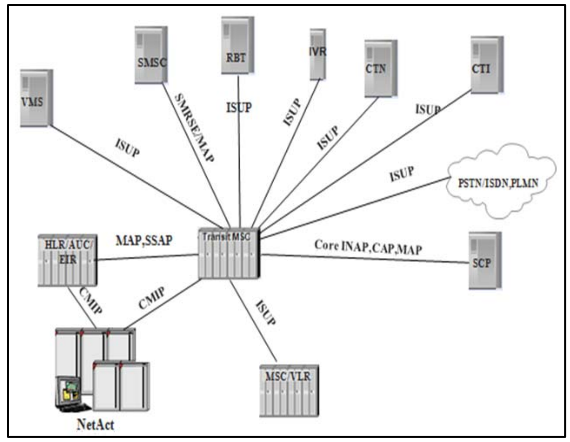

Figure2: interconnection of TMSC

3. TARGET ARCHITECTURE

In this section, we are going to present the architecture which the operator targets through the migration project.
By this project, the operator aims to finalize the swap of all the 2G equipments to offer a network in compliance with the 3GPP R4 which introduces a separation between control layer and connectivity layer [2,10]. So the TMSC equipment will be swapped towards 2 equipments:

-MSC server responsible of signalling exchange.

-MGW sized to support all the traffic of the TMSC.

This new architecture consisted of the only equipments 3G MSS and MGW, offers the double advantage to concentrate the control functions on zones having a dense traffic and to distribute the transport of the traffic so that it will be treated locally on MGW [7].
So the traffic and all the transactions (signalling and voice) supported by the 6 TMSC must be migrated to the MSS / MGW. These last ones must be dimensioning to insure the TMSC's features and the existing services like the interconnection with

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the fixed network and the other mobile networks, platform VMS, IVR, RBT.

4. MIGRATION SOLUTION

To migrate the operator network to UMTS Release 4, the operator must elaborate an adapted strategy which meets the needs ,the technical and economic constraints and which insures the swap of all the features, supported before by the 6 TMSC towards the MSS and MGW equipments.
In this section We present the various migration scenarios of TMSC equipments and its features. Considering the advantages and the inconveniences of 2 scenarios and various existing constraints, we propose an hybrid migration solution.

A. possible migration Scenarios:

Scenario 1:

For an ease of administration, the operator can choose to centralize certain features supported by 6 TMSC in one or two MGW dimensioning for that purpose.
Naturally the efficiency obtained when we concentrate the features supported by 6 TMSC on one or two MGW is the ease of administration and surveillance, and also the optimization of the configuration. As well the centralization of the features which are rarely used can be a very advantageous way to optimize the cost of the swap project.
Nevertheless this scenario has some inconveniences which can be sum up to the complexity and the heaviness of the treatment besides the necessity of using links of big distance to interconnect some platforms or PSTN and PLMN (Public Land Mobile Network)[4]networks with the MGW.

Scenario 2:

When the operator chooses to distribute the treatment of the features insured at present by 6 TMSC on the number of MGW existing in the various target zones.
This scenario has the advantage to allow a bigger flexibility since the treatment of the traffic will be distributed on large number of MGW, on the other hand and opposing to a centralization of the services on the minimum number of MGW required, this scenario requires many MGW and more configuration.
By taking into account advantages and inconveniences of both scenarios and by adapting itself with the existing configuration of each of the features, we proposed the following solution:

Proposed solution:

- **For the interconnection with platforms VMS**

When a operator customer wishes to deposit a vocal message or to consult his voice mailbox, or When this subscriber does not answer, busy or inaccessible the call is sent in the voice mailbox service (VMS) of the city 1 or 2.
So the traffic of all the subscribers possessing this service will be centred in the MGW city1 and city2.

- **For the interconnection with platforms IVR**

The operator network contains some platform IVR responsible for playing announcements, at present each TMSC is connected to a fixed number of these platforms, so to swap this 6 TMSC and their interconnections with platforms IVR, the centralized architecture is more adapted because most of the IVR are concentrated especially in 2 zones 1 and 2, thus implementation of MGWs in 2 zones 1 and 2 will be sufficient to serve the existing traffic.

- **For the interconnection with platforms RBT**

The subscribers of the RBT platform are connected according to their location in the various platforms situated in zones 1,2,3 and 4, so the number of MIC capable of supporting all the existing traffic will be distributed in the existing MGW in zones Where these platforms are located, and this to optimize the transmission and routing cost.

- **For the routing of the traffic towards the national and international transit centres**

Among the main features insured by 6 TMSC is the routing of the traffic from and towards the national and international transit centers, these last ones are installed in big cities .to facilitate the treatment of the traffic and to optimize its transmission and its routing, the number of MIC intended for this feature will be distributed in the MGW installed in these zones.

- **For the interconnection with the other operators**

The TMSC situated in cities 1 and 3 allows the interconnection with the other national operators, this feature will be swapped towards the MSS / MGW. Because the interconnection between the operator network and the other mobile networks is centred on 2 TMSC 1 and 3 then all the swapped traffic will be centred towards the MGW situated in these zones.

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5. EXPERIMENTAL RESULTS

In this section, we have to determine the number of equipments 3G that can replace the 2G TMSC equipments.

For it we firstly propose our dimensioning approach, then we focus on explaining and interpreting the various stages of measures.

A. dimensioning approach:

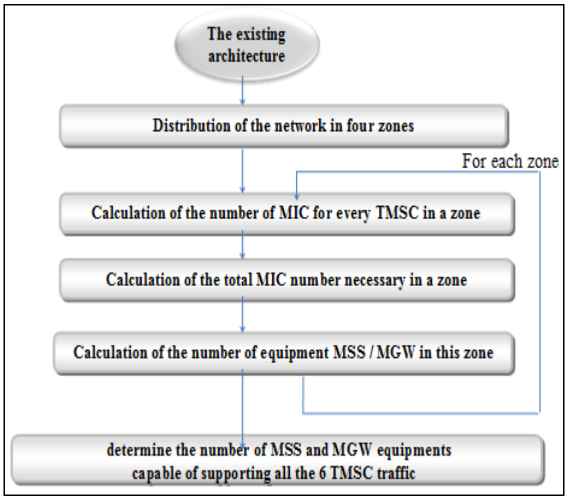


Figure3 : Dimensioning approach

To estimate the number of E1 [9] for every interconnection to swap and afterward to determine the number of MSS and MGW equipments capable of supporting all the 6 TMSC traffic, we will go to study a single TMSC traffic ' TMSC1 city1 '.

B. Dimensioning case study:

The dimensioning study is based on the values of traffic volume during the strong load periods.

The traffic volume is measured during the daily pic hour [8], and then we make the mean measures concerning several days to avoid the non significant values.

To take the traffic measures we interfaced with a traffic measurement tool called SC ' Switch Commander ', we have used some of its commands mainly the GETTRAFILE command which allowed us to extract 2 type of traffic files about the TMSC1 city1.

The first file named USMM whom, converted in an Excel file we were able to find the entering and outgoing traffic volume during all day what allowed us to know the maximum entering and outgoing traffic volume during the peak hour.

The figure 4 shows the interface of the Switch Commander tool:

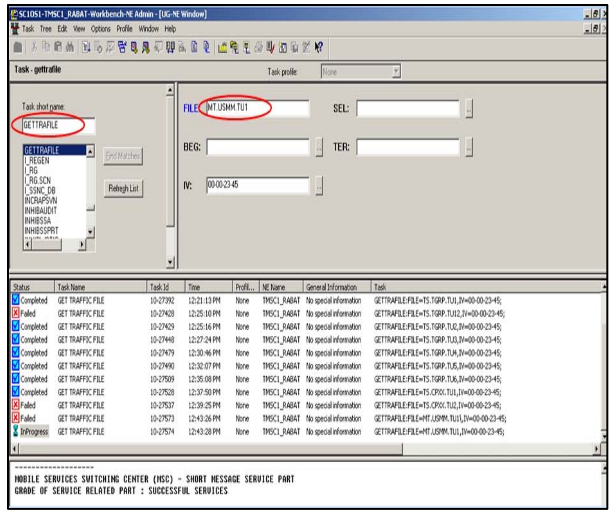
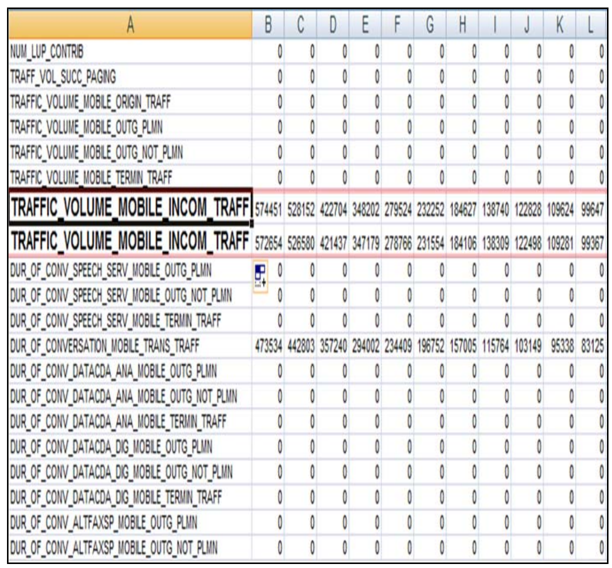


Figure 4: Switch Commander tool

The extracted USMM file was converted in an Excel file what gives the following figure:



A	B	C	D	E	F	G	H	I	J	K	L
NUM_LUP_CONTRIB	0	0	0	0	0	0	0	0	0	0	0
TRAFF_VOL_SUCC_PAGING	0	0	0	0	0	0	0	0	0	0	0
TRAFFIC_VOLUME_MOBILE_ORIGIN_TRAFF	0	0	0	0	0	0	0	0	0	0	0
TRAFFIC_VOLUME_MOBILE_OUTG_PLMN	0	0	0	0	0	0	0	0	0	0	0
TRAFFIC_VOLUME_MOBILE_OUTG_NOT_PLMN	0	0	0	0	0	0	0	0	0	0	0
TRAFFIC_VOLUME_MOBILE_TERMIN_TRAFF	0	0	0	0	0	0	0	0	0	0	0
TRAFFIC_VOLUME_MOBILE_INCOM_TRAFF	574451	528152	422704	348202	279524	232252	184627	138740	122828	109624	99647
TRAFFIC_VOLUME_MOBILE_INCOM_TRAFF	572654	526580	421437	347179	278766	231554	184106	138309	122498	109281	99367
DUR_OF_CONV_SPEECH_SERV_MOBILE_OUTG_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_SPEECH_SERV_MOBILE_OUTG_NOT_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_SPEECH_SERV_MOBILE_TERMIN_TRAFF	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONVERSATION_MOBILE_TRANS_TRAFF	473534	442803	357240	294002	234409	196752	157005	115764	103149	95338	83125
DUR_OF_CONV_DATACDA_ANA_MOBILE_OUTG_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_DATACDA_ANA_MOBILE_OUTG_NOT_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_DATACDA_ANA_MOBILE_TERMIN_TRAFF	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_DATACDA_DIG_MOBILE_OUTG_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_DATACDA_DIG_MOBILE_OUTG_NOT_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_DATACDA_DIG_MOBILE_TERMIN_TRAFF	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_ALTFAXSP_MOBILE_OUTG_PLMN	0	0	0	0	0	0	0	0	0	0	0
DUR_OF_CONV_ALTFAXSP_MOBILE_OUTG_NOT_PLMN	0	0	0	0	0	0	0	0	0	0	0

Figure5: USMM file

Thanks to this Excel file, we were able to find the entering and outgoing traffic volume of the TMSC1 city 1 during all day.

We were afterward able to draw the curve representing the entering and outgoing traffic volume during a day, afterward we were able to find the ' busy hour value as illustrated in the figure 6 which is 20h:45 and also the value of the entering and outgoing volume at this busy hour

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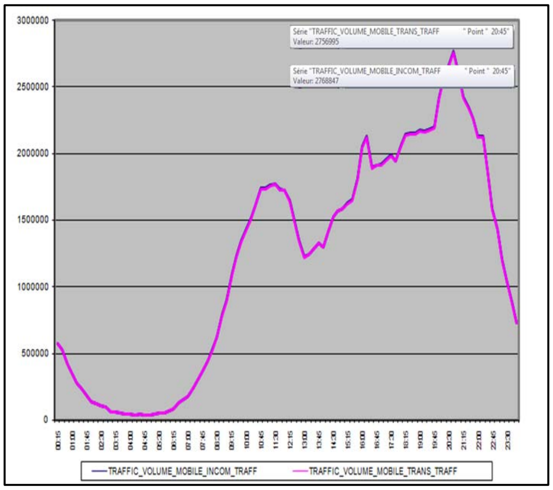

Figure 6 : the entering and outgoing traffic volume during a day and ' busy hour value

The entering traffic volume at 20h45 is: 2768847 Kbits = 1384 E1

The outgoing traffic volume at 20h45 is: 2756995 Kbits = 1378 E1

C. Results:

In this section we are going to determine the number of E1 interfaces connected between the TMSC1 city1 and the other destinations. Every interface E1 contains 32 Times Slots of 64 kbps for each Time Slot, what makes a total of 2.048 Mbps. All Time Slots are used for the traffic transport with the exception of the TS0 used for the synchronization.

By knowing now the busy hour value, we were able thanks to a small program written in Java to treat GETTRAFILE files and draw from it the following conclusions representing the distribution of the TMSC1 city1traffic

For each destination of the TMSC1 city1, we found the number of trunk group as well as the number of lines or channels connected with this destination, after subtraction of the number of blocked lines, we are going to calculate the number of E1 interfaces towards all the Destinations.

For this, we used the following formula:

The number of channels = number of connected lines - number of blocked lines

The number of E1 interfaces towards a destination x = the number of channels / 31

destination	VMSC2 (2346)	VMSSALE (3029)	RBT	CTI	CTN	IVR
CONNECTED LINES	973/776	180	403/310	682/1411	3035	10x120
NO OF BLO LINES	31/60	52	0/0	0/62	155	120+30+1+120
N°E1 connecté	30+23=53	4	13+10=23	22+43=65	92	30

Figure 7: calculation of E1 connected number for each interface

The following board summarizes the number of E1 interfaces connected with the various destinations of the TMSC1 city1

destination	number of connected interfaces
VMSC1	53
VMSC2	4
RBT	23
CTI	65
CTN	92
IVR	30

Figure 8 :E1 connected number of TMSC1 city 1 with each destination

The calculation of the MGW required number depends on several parameters. This number depends mainly on the network topology , on the traffic and on the type of traffic.

The capacity of the MGW is a function of interfaces, traffic, signalling transport and the capacity of call control. It depends on several parameters as the used codec, the interfaces and their uses with regard to the chosen call profile and on the used services. Thus It is essential to have a defined call profile to be able to dimensioning the number of MGW.

In our study, we limited to calculating the number of required MGW interfaces which can support all the traffic in transit from TMSC towards its destinations.

We proceeded to a case study of a single TMSC, we shall calculate afterward the number of required interfaces to insure its interconnection with the fixed network, the platforms VMS, IVR, RBT, and the other mobile networks.

The previous study by which we obtained the number of connected interfaces for each destination, gives us a total of 267 connected interfaces.

Then in conclusion, to swap the traffic of the TMSC1 city1 towards the MSS / MGW, 267 interfaces are required. This number must be distributed according to the migration scenarios seen previously.

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6. CONCLUSION AND PERSPECTIVES

The problem treated in this article is the migration of 2G remaining TMSC equipments in the operator core network towards new 3G MSS / MGW equipments. We were firstly able to elaborate a migration scenario to swap 6 TMSC as well as its features towards the MSS / MGW and after that to elaborate a dimensioning case study.
However other dimensioning works are still necessary to finalize our study, it consists particularly in calculating the number of E1 connected interfaces of the other TMSC equipments implanted in the other zones. Based on this number we will be able to calculate the number of the necessary MSS/MGW equipment in the migration process. The interest of such a work has a big impact to start NGN architecture deployment.

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