The new Interconnecting Television: An alternative approach to next generation broadband networking

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Abstract— **In Sevilla European Council it was indicated that two major problems (among the others) have to be solved towards eEurope 2005 and beyond: the transition to digital television in UHF band (digital switchover) and the broadband access for all. This paper considers that if proper decision will be taken for the digital switchover (taking into account the networking aspect of the new television) it will also provide a solution for the second problem (the broadband access for all citizens). It presents an approach towards the solution of the digital switchover that comprises the use of the DVB stream for interconnecting next generation network (NGN) nodes, by the use of regenerative configurations. The utilisation of regenerative configurations enables for the realisation of a virtual common Ethernet backbone that can be exploited by 3G/UMTS and B3G operators and broadcasters, besides enabling for broadband access for all citizens.**

Index Terms—**Broadband access, digital switchover, digital video broadcasting, interconnecting television, next generation networks.**

I. INTRODUCTION

Despite the intrinsic technological differences between Telecommunications and Digital Broadcasting sectors, a notion of convergence has been recently achieved not only at technological level, but also at service level.

This convergence was mainly empowered by the work carried out in the field of 'Interactive Broadcasting', which was the subject of innovative work carried out by a number of Research and Development projects in the 5th European Framework Programme. The ultimate goal of these projects was to provide new affordable services to the users, fulfilling two observed tendencies: i) the personalisation of services, that cannot be offered by traditional one-to-many broadcasting networks, and ii) the consumption of bandwidth hungry multimedia services that cannot be offered by existing communication networks especially on the move. The objective of further development of the subject of Interactive Broadcasting was confronted by the European commission in a lately organised workshop [1] that identified the technological and service issues which require further R&D including: i) video and audio delivery to mobile terminals, ii) traffic symmetry/asymmetry, iii) market prospects of the introduction of new services and applications, vi) regulatory and spectrum issues, and finally, and most predominant, the need of synergy (better than convergence) between broadcasters and telecom operators towards the introduction of the next generation networks (NGN).

The Sevilla European Council expressed Europe's current interest for next generation networks by defining the actions-to-be-taken and by identifying the issues to be studied in depth (and in parallel) prior to the deployment of NGN. Two of these issues are (as they appear in the Sevilla document) [2]:

The digital switchover. "In order to speed up the transition to digital television, Member States should create transparency as far as the conditions for the envisaged switchover are concerned. Member States should publish by end 2003 their intentions regarding a possible switchover…National switchover plans should also be an opportunity to demonstrate a platform-neutral approach to digital television, taking into account competing delivery mechanisms (primarily satellite, cable and terrestrial)".

The broadband access for all citizens' "… In the wider context of the European Research Area project, the Commission is supporting the full exploitation of broadband networks by the research community…A broadband strategy will have a complex task as it is affected by many different policies: town and country planning, research policy, taxation and regulation. … The Commission will deepen the analysis of policy options and existing obstacles to broadband deployment, in particular with a view to widespread access to new services through open platforms in digital television and 3G …".

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This paper presents an approach towards these points, by adopting the issue of 'Interactive broadcasting' and by taking it one-step-beyond: the 'Interconnecting Television'. Realising the networking capabilities of the digital television (DVB), it proposes a solution to the digital switchover that comprises the use of the DVB stream for interconnecting NGN nodes, by the use of regenerative configurations. The utilisation of regenerative configurations enables for the realisation of a virtual common Ethernet backbone that can be exploited by 3G/UMTS and B3G operators and broadcasters, besides enabling for broadband access for all citizens. In this respect, this paper considers that if proper decision will be taken for the digital switchover (taking into account the networking aspect of the new television) it will also provide a solution for the second problem (the broadband access for all citizens).

After this introductory section, the rest of the paper is organised as follows:

II. CURRENT STATUS

Studies and recommendations, which have been provided to the European commission since April 2002, indicate that the vision of eEurope is far away than 2005 due to clashes between the broadcasting and telecommunication sectors in the market and business fields. Digital switchover and broadband access for all seems to be individually studied by the different sectors and not in depth. Most documental reports are focused on how such technical issues will affect the business and market plans of each sector. For example, from BIPE's study [3] and from the countermand reports produced by several broadcasting enterprises (i.e. BBC, EBU), it is evident that the major obstacle towards digital switchover (that will lead to the NGN and eEurope) is the spectrum valuation and the sharing of frequencies, especially in the UHF region. Telecom operators require part of the UHF band to be allocated for mobile communication, while broadcasters proclaim their ownership of the entire frequency band. No comment and/or no remark are made on the broadband access and its relation to the digital switchover, and eventually neither the broadcasting nor the telecommunications sector foresees synergy between them. Major barrier to this is that both sectors see the digital switchover as for their own benefit, towards their own business success, ignoring the social and market benefits that it can provide to all citizens around Europe if broadband access is offered in parallel with the digital switchover. Currently, both broadcasters and telecom operators consider citizens of Europe as passive consumers/clients of their content/services, and they foresee an increase of such a custom when digital switchover becomes a reality. The passive citizen who receives predefined content/services/applications seems to be the target group of these sectors, which will raise their income and boost their business viability. The active participation, however, of the critical mass of potential content/application providers (stemming from traditional users) in the market is the key to, generate revenue, gear up rich activity in the market chain and spear new progress in both the broadcasting and telecommunication sectors, besides attracting new consumers. The critical missing link to enable this active participation of all potential content/application providers, is a broadband access infrastructure, which will decouple the service provisioning function from the network operators and offer this privilege, to all interesting players (active citizens/users) introducing innovative services, generating revenue, competition, quality and market opportunities.

Allies in this situation are all political and governmental authorities of Europe which maintain the current frequency legalisation and spectrum valuation. As they are unaware of the capabilities and potentialities of the new technologies in the field, they cannot take the proper decisions and make the appropriate legislations, unless clear results concerning the digital switchover and broadband access for all are provided.

Nevertheless, Europe has a vision for next generation networks that must confront the needs for both broadband access and digital switchover, besides fulfilling the requirements for social, humanitarian and man-about networks. Such issues must be examined in depth and in parallel with "… new approaches to spectrum valuation and trading of right-of-use of frequencies", towards the deployment of NGN, the realisation of eEurope 2005 and beyond, and the accomplishment of the European Information Society.

III. TOWARDS NGN

Since DVB stream can easily encapsulate IP datagrammes, it becomes an extremely flexible backbone for a powerful IP infrastructure. The overall architecture of such an infrastructure (see figure 1) comprises two core subsystems: I) a number of Cell Main Nodes (CMN), and II) a central broadcasting point. Each CMN enables a number of simple users (geographically neighbouring the CMN) to access IP services hosted by the network. The communication between the simple users and the corresponding CMN is achieved via broadband point-to-multipoint links (i.e WLAN). The CMN gathers all IP traffic stemming from its users, and forwards it to the central broadcasting point (UHF transmission point visible by all CMNs) via dedicated point-to-point links (uplinks). IP traffic stemming from all CMNs is received by the broadcasting point, where a process unit filters, regenerates and multiplexes them into a single transport stream (IP-multiplex) along with digital TV programme(s), stemming from the TV broadcaster(s), forming the final DVB-T "bouquet". The regenerated/combined traffic is then broadcasted via the UHF channel at high data rates following the DVB-T standard. Each user receives the appropriate IP reply signals indirectly via the corresponding CMN, while receiving the digital TV programme directly via the UHF channel. In such configuration both reverse and forward IP data traffic are encapsulated into the common DVB-T stream, thus improving the flexibility and performance of the Network.
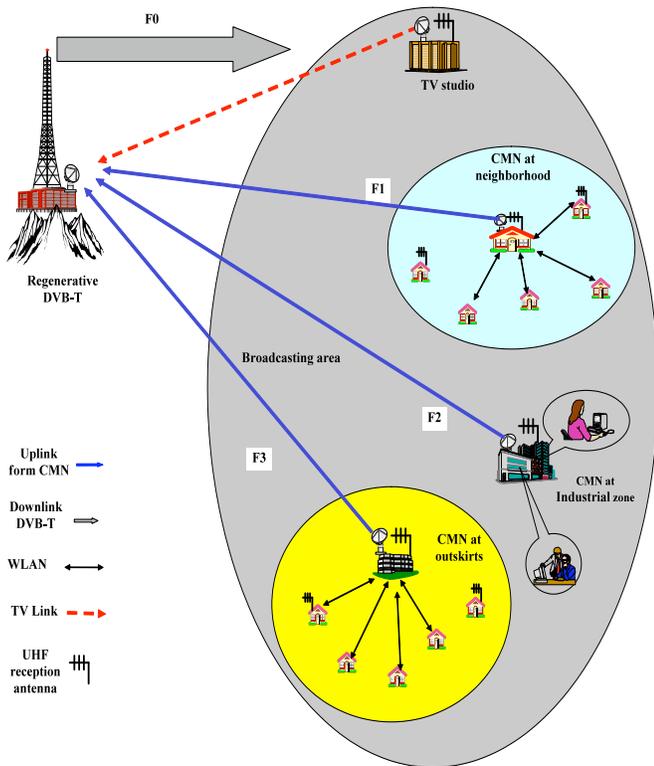
Fig 1. Overall architecture.

The cellular conception that is adopted utilises DVB-T stream in a backbone topology which interconnects all cells that are located within the broadcasting area. Thus, a unique virtual common Ethernet backbone is created, which is present at every cell (via its Cell Main Node). The IP traffic of this Ethernet is supplied by the DVB-T bit stream, to all users who access the network via the appropriate Cell Main Node. Eventually, each CMN constitutes the 'physical interface' to the common Ethernet backbone of:

  A service/content provider (i.e. ISP).
  The users/citizens of a local network (intranet).
  The customers of a mobile network operator making use of 3G and B3G technology (i.e. UMTS).
  Individual active users and implicit service providers, who create, manipulate and provide their own content to the entire network (i.e. e-businessmen).

In such configuration, all kind of citizens/providers are co-equal users of the same infrastructure via which they access (or provide) IP services. Such implementation can be used and exploited as common infrastructure by 3G and B3G operators and broadcasters having independent business plans and different users/clients.

The described network configuration utilizes the new television (DVB-T stream) in a backbone topology, in order to distribute interactive IP services (and digital TV programmes) and interconnect users of a metropolitan area. Extension of this configuration can be achieved by using a regenerative satellite, in order to interconnect nodes and users around Europe (see figure 2). Such a configuration, in conjuction with a real time bandwidth optimisation mechanism, is investigated in the IST project REPOSIT (IST-2001-34692) [5].
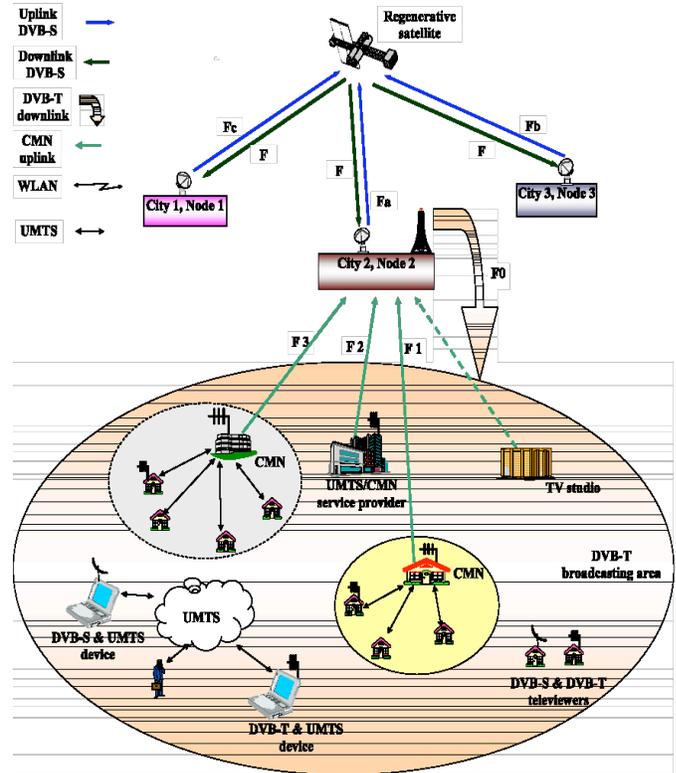

Fig 2. Interconnecting citizens across Europe via the television beam.

IV. ENVISIONING eEUROPE 2005

As already mentioned, the existence of a regenerative terrestrial platform in a city (DVB-T) is an infrastructure which provides not only a bouquet of television programs, but also (and most predominant) creates a powerful broadband IP backbone. Such an infrastructure will not be a competitor to current broadcasting enterprises such as the satellite television industry, which denotes the continental or global aspect of television, but a supplementary one as it sets-off the local aspect of it besides focusing in the IP capabilities that it can offer. The adoption of the networking and the local aspect of the DVB will have evident results on the market and social life of Europe.

Such an approach is the only possible compromise between TV broadcasters (who want the entire UHF band) and 3G operators (who claim part of this bandwidth for exclusive use). The implementation and utilization of such a neutral infrastructure, which does not belong to any broadcaster or 3G operator, could be the first step towards eEurope 2005, as it can be used and exploited by any potential service/content/application provider (i.e. broadcaster, 3G operator, active citizens/users) who have independent business plans and different target groups of clients.

In such an infrastructure a businessman who is involved with the provision of IP services will utilise/consume some

Mbps of the entire DVB-T downstream and will be able to set up his business based on his own criteria (i.e. QoS, content, etc). A broadcaster will transmit his own "bouquet" of TV programmes (from his studio premises) that will be addressed to television viewers via the common DVB-T downstream, while ignoring the existence of the other service/content provider (e.g. the IP service provider) who has set up a whole IP business that is addressed to another world (IP-world) in the same city. Evidently, all kind of service providers (broadcasters, 3G operators, ISPs) and any kind of users (simple television viewers, IP users, TV and IP users, active users, implicit service providers) can be accommodated by the proposed common and regenerative DVB-T infrastructure. Such a regenerative and neutral DVB platform can be used and exploited as common infrastructure by 3G (WLAN, UMTS), B3G operators and broadcasters having independent business plans and different users/clients. It can offer a basic broadband telecommunication backbone in the city for the development of businesses involved in new technologies (from ISP up to innovating e-commerce etc) and/or the creation of new market places or the development of spin-off activities with evident consequences on the working force, besides preserving the local aspect of the UHF services, with obvious cultural consequences.

Any doubts and hesitations of the political and business world would have been much less – and the barriers for the digital switchover would be disappeared - if the political authorities were notified about the network potentialities that a DVB-T platform can offer in a city, and the direct impact it has on the creation of new employment positions for young people that could be activated from their home/city.

Towards this, exhaustive performance evaluation tests, public presentations and several demonstrations under real condition environment must be utilised that will provide useful results concerning the networking potentiality of the DVB stream. These results will be a useful feedback for the existing service/content providers (a broader market will be open for them) and the new type of businessmen (potential/implicit service providers that can distribute their own content to the entire network). Furthermore, such approach will provide useful information to the local and political authorities, by notifying them about the networking dimension and the local aspect of the new digital television. Such notification will be essential prior to the decisions to be taken for the digital switchover, the right-of-use of frequencies and the frequency legalisation procedures.

V. CONLUSIONS

Accomplishment of Europe's vision for the next generation networks requires extensive study and in depth examination of the digital switchover, broadband access for all, and the spectrum valuation issues. Currently, there is no clear point that such action have been taken, neither by the interesting sectors (broadcasting and telecommunication), nor by the political and governmental authorities. Major barriers are the political authorities' unawareness about the potentialities and

advantages of the new technologies, and the clashes between the broadcasting and telecommunication sectors in the market field. This paper presented an approach that contributes towards the digital switchover, by proposing the issue of the 'Interconnecting Television'. The use of the DVB as a common backbone for NGN node interconnection in a neutral infrastructure (exploited and used by any current and/or implicit service provider) arises as a possible compromise between the different sectors, which can maintain their profit, besides increasing their customer groups. Citizens/users of such an infrastructure will accommodate broadband access to the provided services, besides becoming implicit service providers of their own content/services/applications, capable to be distributed to the entire network.

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