Broadcasting Media Platform based on locally unused uhf spectrum

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Abstract
A concept for "Broadcasting Internet" is presented, based on the exploitation of any unused uhf spectrum at local level (such as interleaved spectrum) in all European countries, cities and conurbations. The proposed approach is based on networking architectures that use the interleaved spectrum to create IP wireless backbones in UHF and offer new wireless infrastructures, able to serve entire cities and conurbations around Europe (broadcasting media internet). The European networked media sector could be a valuable candidate for the utilisation of this extremely important spectrum targeting the realisation of wireless infrastructures at the "user centric" media concept.

Background
It makes now almost 50 years since the analogue TV has been introduced in Europe. All these years the UHF spectrum was under national/governmental control and its use was reserved for TV transmission (local, national). Since then, 49 frequencies in the UHF were allocated to the TV broadcasters in order to assure total coverage in each European country. The common target was to assure total coverage in national level by using the minimum number of frequencies out of the 49 allowable, and the minimum number of transmission points.

The coverage implementations plans and models in the different European countries were more or less the same (starting from a basic classical model of hexagons or octagons) taking into account the particularities (like relief etc.) of each country and the coverage target obligation to assure country coverage near 100%. According to all coverage implementation models any engineering design, assuring national wide coverage, leads to the same result: only few frequencies (maximum 7) could be used at every transmission point. All the remaining frequencies at this specific point remain unused. However these frequencies are used in other transmission points all over the country (interleaved channels).

The recent transition to the digital transmission has changed the terminology. Now, for example, we refer to 7 national coverage bouquets, each of which could include 4 to 12 or more television programs depending on the coding and compression techniques (DVB-T, DVB-T2, Mpeg-2, Mpeg-4, etc.). But in terms of the electronic engineering level, the DSO will not change (or will change very slightly) the coverage implementations models in European countries since these national implementations concern UHF engineering transmission, that is the same spectrum, the same channels since the "analogue period" and the same basic models concerning universal coverage deployment. The strict obligation of any National Broadcaster (analogue era of public television or national coverage bouquets nowadays) is still to supply every citizen of the country, wherever they might reside, with the same content, i.e. the same TV programmes (100% coverage in terms of population). This obligation makes the

design of national coverage implementation, a time and resource consuming technological achievement. A successful implementation lies in the achievement of a "no white space spectrum areas country", since a good reception of at least the 7 bouquets must be assured for any location within the country. As a consequence, additional uhf spectrum is used in both urban agglomerations (secondary transmission centres, "dark urban areas") and rural areas (gap fillers as repeaters-on band-or as transposers utilizing locally available interleaved spectrum). For this reason even after the DSO, the number of interleaved channels will be more or less as high as it was during the period of the analogue broadcasting transmission. In practice all models assuring national coverage use 6 or 7 frequencies, thus leading to more than 35 interleaved frequencies, as depicted in Fig.1.

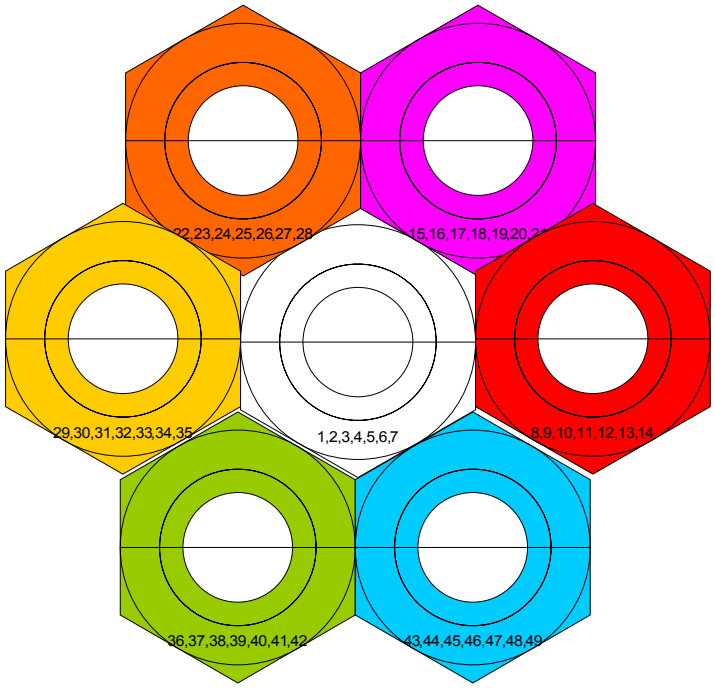

Fig.1: Theoretical model for national coverage in case of maximum number of bouquets (i.e. 7 bouqets). In such a case the usage of all 49 channels is needed and as a result all 49 channels are "transformed" into interleaved channels (without any spectrum dividend).

The first significant proposal to exploit the uhf spectrum allocated to TV transmission as "free access" and CUS (Common Use of Spectrum) approach comes from the so called "White Space Coalition" in the USA using the term "TV white spaces". The technical approach of the CUS proposition is based on **the use of full duplex (using UHF TV channels frequencies)** "cognitive devices". Not hiding their anxiety about possible interference in the transmitted TV programs, the entire USA Broadcasting Sector is strongly opposite to this idea characterising the WiFi-like full duplex "white space" devices as 'germs,' that will spread throughout America with the ability to attack the TV receivers in people's homes, apartments, hotel and hospital rooms, etc., with no way for the owner of the TV set (the 'victim') to determine who was causing the 'illness' to his or her TV set.

Another key disadvantage of the CUS model is that, once a spectrum band has been designated for CUS, reforming for any other use is likely to be difficult. Even if

‘better’ services emerge in future, old equipment is entitled to stay in use for many years. Since the location of this equipment will be unknown it may, in practice, be impossible to clear the band. CUS allocations in a shared band could potentially impose constraints on the evolution of primary users in the band.

Our proposal, on the other hand, is based on the following keystones that are of vital importance for the broadcasting sector as far as the future use of the UHF spectrum is concerned:

1. The interleaved UHF spectrum philosophy remains the same that is **one-way transmission**.
2. The interleaved UHF spectrum remains **reserved (allocated) to TV and Audiovisual services** and not to the collective use of spectrum approach (CUS).
3. It **allows any future development**, innovation, design and applications.
4. It offers a **novel approach to future broadcasting** by realizing new infrastructures (Broadcasting Internet Platforms) in any European conurbation.

Broadcasting Internet approach

The proposed approach is based on the idea that any unused uhf spectrum (called interleaved spectrum), extremely important in local level and virtually capable to be an important factor of regional development, can be used for the implementation of new wireless infrastructures (**wireless Ethernet backbones in the UHF**). Converging DSL infrastructures with broadcast technologies offers access to new players in the market chain (content creators, innovative businessmen from the networked media sector, active users.

Ethernet backbones are generally wired or optical and they are offered by telecommunication sectors. The proposed Broadcasting Internet concept anticipates that the interleaved UHF spectrum can create in every city/region another wireless Ethernet local backbone, particularly rich in bit-rate and available in the entire city's/region's area. The proposed network infrastructure has its own content created locally by local content creators (active users) and an autonomous address system**.** The overall architecture of such an Ethernet/wireless/infrastructure comprises two core subsystems: i) a central terrestrial transmission point (namely broadcasting platform) where the common Ethernet/IP backbone is created and provided over the UHF beam, and ii) a number of Nodes located within the coverage footprint, which enable citizens not only to access predefined content (interactive users), but also and most predominantly to deliver their own services to the entire city (active media creators).

The proposed **“Broadcasting Internet Architecture”** is that of a generalised Backhaul which covers the whole area of an entire conurbation through the **interconnection of the local Ethernet of all Nodes** (access points). A key feature of this architecture is that, like the Ethernet cable, it **does not** support the concept of **forward and reverse path (full-duplex devices).** In the Ethernet cable the communication is done based on the address and not on the physical link. The proposed architecture is doing exactly the same. It creates a unique virtual common Ethernet which is present in the entire Conurbation and is accessible from any point of the conurbation. In this respect, the connection from a Node to the Broadcasting Platform may be called (according to the ordinary terminology) as **the reverse path** channel for **the active user** (carrying the data requests/ acknowledgements), who

requires access to services/content hosted by any other provider within the entire network. **The same physical link** may be also called as the **forward** channel for the abovementioned "other provider" who accesses the services hosted by this **active user.**

The classical definition of interactive broadcasting/interactive television is something different, as it involves two physical links; the first physical link is a telephone line with the broadcaster's platform and the viewers ask for content from the broadcaster. The content is provided via the second physical link i.e. the broadband dvb-t beam. This is called diversion. In our proposition we do not speak about diversion. Once there is no broadcaster in the platform, there is absolutely no content to provide. What the platform is doing is to create a "wireless Ethernet cable" that expands in the entire city. Therefore this "wireless' cable has its own IP addresses, and the conventional terminology of uplink and down link is no longer valid.

Using Ethernet backhauling to realize the infrastructure, allows multiple Ethernet LANs or individual single active users-citizens at different points around the conurbation to be connected together as if they were connected to the same Ethernet segment. The IP traffic of this Ethernet is supplied by the uhf channels bit stream. Users access the network via the appropriate Node. In a configuration like this, all kind of services providers are co-equal users of the same infrastructure through which they access and provide IP services. Such an implementation can be used and exploited as a common infrastructure by service providers having independent business plans and different users/clients. The number of IP services, which can be supported by this infrastructure is very large- according to the total bit rate of the locally available channels that will be used, and the bit rate required by each application. Most of these applications (IP multicast, carousel, etc.) are services offered by the active users to all citizens of the conurbation (passive TV viewer of national and local Bouquets). The total bandwidth is sliced into Virtual IP Channels and each channel into a number of services whose bit rate can be variable and dynamically changed.

Conclusion

Multimedia services are of major importance for every citizen and new technologies must support content creators to present and distribute their work to the audience, in the shake of the general social interest. Access to the infrastructures must be therefore encouraged and facilitated. By exploiting the unused uhf spectrum any city/conurbation can automatically acquire the basis for a powerful IP broadband infrastructure with extremely low cost. The proposed configuration accommodates the true interactive user, who is allowed not only to receive content but also to create, manipulate and deliver it. In this context, the proposed infrastructure aims to cover the fundamental needs of all citizens by supporting i) the passive and interactive viewers with the reception of conventional and/or interactive multimedia services, interactive multimedia creation and delivery and ii) the active media creators with the promotion of innovative e-commerce business, spin-off companies, professional participation in Information Society's activities and applications. In this context, the local and one way aspect of UHF spectrum is preserved and is used for the development of local activities in the field of new technologies, affecting positively the political life, the cultural preservation and the evolvement and progress of entire regions.