Digital Broadcasting in Slovenia - Implementation of spectrum planning policy on regional scale

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ABSTRACT

In the following paper the perspectives of spatial development of digital broadcasting in Slovenia will be presented. Digital broadcasting will be considered in two main streams – digital audio broadcasting and digital video broadcasting, both in the terrestrial mode.

In the field of digital radio, T-DAB frequency block allotments were already coordinated at the Wiesbaden planning conference in 1995. The analyses of the spatial coverage of allocated frequency blocks will indicate variety of problems raised in this matter.

Meanwhile, the digital terrestrial video broadcasting (DVB-T) service is available in Slovenia in the test mode operation on channel 37. Present European DVB-T networks are operating using the channels coordinated in Stockholm 1961 and revised in Chester 1997. The new spectrum planning conference dealing with the frequency spectrum for digital terrestrial video broadcasting is schedulled on 2005. Planning considerations of the DVB-T spectrum are even more complex than those of the spectrum planning processes for digital radio. Some new issues such as availability of new services, portability and interactivity will be indicated.

1. T-DAB DEVELOPMENT

On a European scale the T-DAB (Terrestrial - Digital Audio Broadcsting) development is undoubtedly in a crisis. We are dealing with a system which, in spite of its technical excellence, has not come to life. This is primarily due to the fact that there has not been enough frequency space for the introduction of new technology. The first priority of introducing the digital radio only two frequency ranges available, i. e. Band III (220 MHz) and L Band (1.5 Ghz). The L band is more suitable for local radio networks. Only the French decided to utilize this band as the first priority, while the other European countries started introducing T-DAB networks in Band III, which is nowadays used for the distribution of TV programmes. As a result only one TV channel (Channel 12) is available in the introductory period, which may host four T-DAB multiplexes. This frequency band is mostly planned for the national coverage in SFN mode, and the L range in most European countries is reserved for local coverage.

In 1995, at the Planning Conference in Wiesbaden Europe gained its first plan of introducing the T-DAB.

1.1 Difficulties of T-DAB Introduction in Europe

With the introduction of the T-DAB it obviously seems that not all conditions were present, necessary for a successful adoption of a new system. Particularly important is the content and the economics of it all, which – in addition to the advanced technology – represent a firm basis for the implementation of the new system. Maybe too much attention has been paid to the technology. Technically this is undoubtedly an extraordinarily perfected system. It eliminates the weaknesses of FM radio, which was never designed to be used in a car. Along with the expansion of the automobile industry the radio receiver appeared as a standard equipment item. The difficulties, typical of the reception of the analogue FM signal in a vehicle were impossible to eliminate, as this is a question of physical laws, which was impossible to compensate in the analogue system. In the first place there is the Doppler effect and the phenomenon of delayed reflected radio waves – the so-called multipath effect. The above-mentioned phenomena are the main hindrances to undisturbed reception of FM radio signal. The same physical laws, which apply to the mobile communication channel, have been turned by the new digital system T-DAB into its own benefit. In this way the multitude of reflected waves even contributes to a better reception, and simultaneously also enables the introduction of the concept of the so-called SFN networks, which substantially enhance spectral efficiency.

Yet, as mentioned before, in addition to technical quality DAB system lacked a few conditions, compulsory for the successful implementation of the new technology. The greatest hindrance is a lack of a necessary radio frequency spectrum. This was the reason why it was not possible to locate in the new system all radio stations, which are nowadays present in the analogue system. Here it has to be added that – owing to the same reason – it was also not possible to add new services or programmes, which would provide the system with a more attractive image. This is a very important factor, which influences the user, when he decides about purchasing a new radio receiver. Prior to the decision of purchasing a new receiver, which – by the way – still costs a lot, one has to answer a few questions.

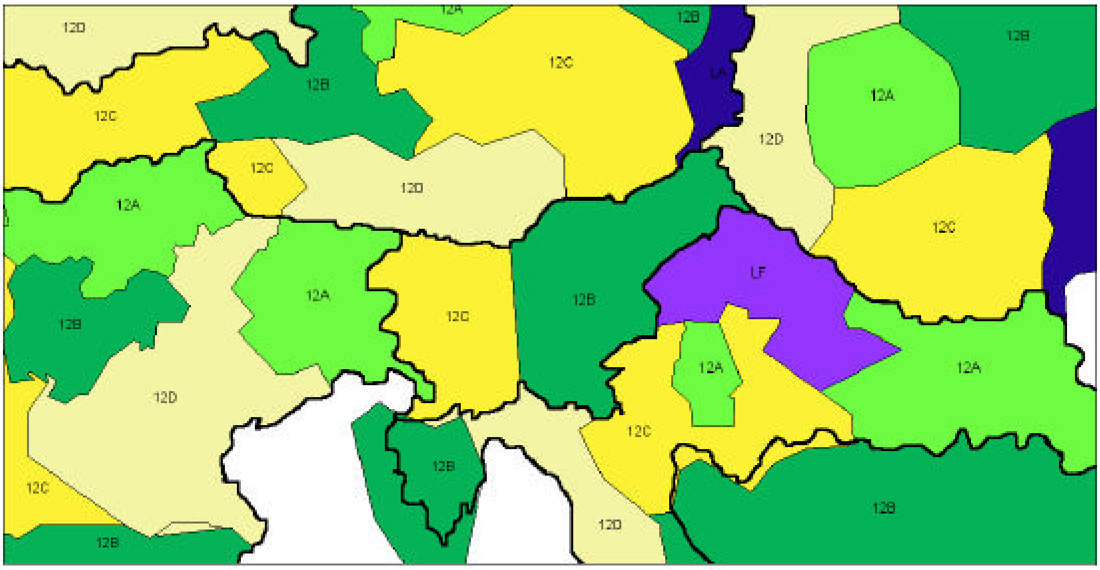
Why replace one's old FM receiver, for which we can state, that it functions perfectly. Users do not complain about technical quality of the reception and sound itself. While deciding upon an investment in a new receiver, the main role is played by new programmes and services. The above-mentioned difficulties which accompany the introduction of T-DAB have the greatest impact on the contents itself. The user may be attracted by new contents and new services, added to the existing ones. New services are necessary conditions for the creation of a new value, which may represent an additional economic impulse with a more highly placed value towards the digital radio.

1.2 Difficulties in Slovenia

We can say that – on a European scale – the introduction of digital radio (T-DAB) is in a crisis. This statement also applies to Slovenia, as we have not come beyond the installation of a test transmitter at the broadcast transmitting centre of Krvavec, which presently no longer functions. Generally, we can state that with the introduction of T-DAB most difficulties arise in the spectrum area. Although at the Wiesbaden Conference [1, 2] a frequency alltoment plan was adopted for the start-up of digital radio networks, it does not provide sufficient quantity of frequency spectrum for the operating national, regional, and local radio programmes. With this statement we estimate that, even in the case when all radio programmes had enough space within the new system, this still would not be a sufficient condition for a succesful introduction of the new system, as the user does not gain any new service with it, while the network providers and the content providers do not perceive added value in the new system. Actually, this is a difficult business model of new network introduction, as it does not offer new services which – on one hand – would attract users, and – on the other hand – would cover the costs of replacement of transmitter networks and receivers through the newly added value. In Slovenia, in addition to the above-mentioned objective difficulties, we are also facing the process of regionalisation, which is one of the conditions of our access to the European Community [3,4]. The planning of digital radio broadcasting networks should be co-ordinated with the policy of regional spatial development of Slovenia. Yet, the regional division of Slovenia progresses slower than the European policy of introduction of digital radio broadcasting, which additionaly burdens the planning of new networks [5,6].

Digital broadcasting development in Slovenia is still in its initial stage. Digital radio does not operate yet. Beside the trial in 1997, which mostly served the technical demonstration of the system, Slovenia did not conspicuously dedicate itself to the introduction of digital radio. There are several reasons for such a situation.

In Slovenia there are even more reasons for a non implementation of DAB. First of all there is the previously described problem of a lack of spectrum, and an even more the burning problem of regionalisation. As a rule in Slovenia the regions have not yet been defined as a subject of the economy. In the process of becoming a member of the European Union one of the important tasks is the definition of regions. At the very time of composing this paper we have only got three regions from the statistical 12 regions, i.e. East, West and the Ljubljana capital area. At the Planning Conference in Wiesbaden, as a result of an unidentified spatial orientation, Slovenia received a frequency plan of introduction of the T-DAB, which reflects the actual condition of the unidentified regional policy. Therefore, let us see the frequency allotments in Slovenia, as compared to neighbouring countries.



Graph 2: Slovenija T-DAB allotment 1st priority

With neighbouring countries it is obvious that frequency bands were co-ordinated on the basis of their regional administration units.

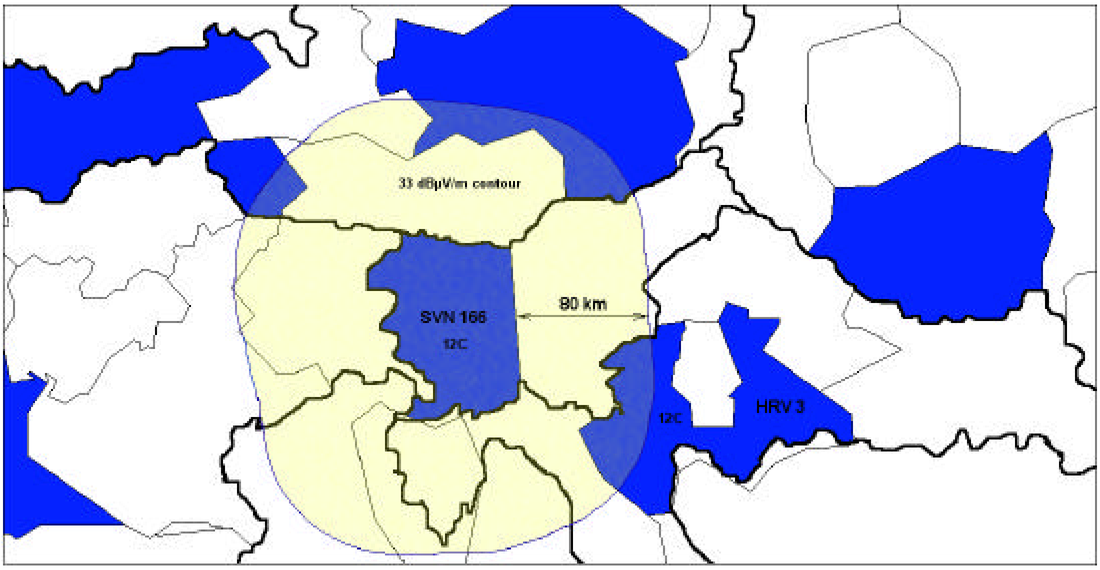
In Croatia these are »zupanije«, in Italy »provinces«, in Hungary »komitate«, and in Austria »bundeslaender«. Slovenia co-ordinated frequency bands with the neighbouring countries, considering technical planning parameters, and, under the above-mentioned lack of clear regional space policy the frequency plan arose, which does not enable the construction of the national SFN network, for the distribution of national programmes. Herewith the capital, with many local programmes is divided into the eastern and the western part. In the eastern part of the country, in which Maribor, the second largest town is located, which also has an equal abundance of local radio programmes, there is not enough frequency spectrum either.

An example of a coverage of the capital city

Let us recall the Wiesbaden planning technique. It was based on the frequency allotment planning. This concept is based on the T-DAB Allotment area and a construction of the interference contour around such area, which is defined by isofieldstrenght contour set at 33 dBμV/m. The line crossing the City of Ljubljana is a boundary line for slovenian national ensembles in 1st priority and simultaneously the calculation test points for specific unwanted fieldstrenght which may come from the neighbouring contries using the same frequency block.

The boundary line between East and West frequency block of the 1st priority goes directly through the Capital city Ljubljana and divides Ljubljana basin which is a very homogenious “region”, into two parts. In the case of national digital radio coverage those two blocks should carry the same programmes in order to achieve national coverage. The rest od capacity of both multiplexes could be used for local programmes which will serve a rather large teritory – a half of the state. Ljubljana basin can be covered with both multiplexes but special consideration should be taken into account in protecting the same frequency blocks of the neighbouring States. If we decide to extend the west or east sevice zone in order to cover the Ljubljana basin with both multiplexes, special care should be taken in protection to other services.

If the west DAB allotment SVN166 would be extended to cover the Ljubljana basin a possible interference can be expected in the Croatian allotment HRV3. In order to avoid this situation a special care on transmitter radiation directions must be applied. The distance between those two allotments is only 55 km.

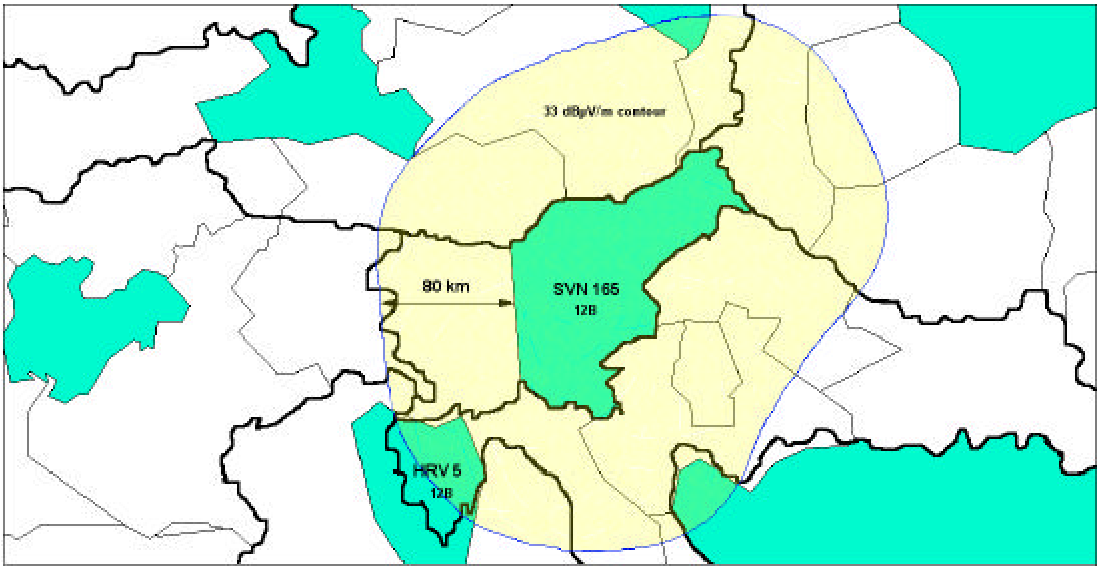


Picture 5.3: isofieldstrenght contour of SVN166 frequency block

Croatia	Italia	Austria	Hungary
HRV 3	Lombardia VHF	Steiermark	Hngsouthwest
	Umbria VHF	Tirol	
	Puglia VHF		
	Sicilia VHF		

Table 1: Usage of Block 12C

On the other hand, if the East allotment SVN 165 is extended over the Ljubljana basin, the problem is the same with the Croatian allotment HRV5 (Istria). The distance between those two allotments is only 45km. Newetheless with a carefull planning of DAB transmitter systems it is viable to solve the problem of Ljubljana basin coverage.



Picture 5.4: isofieldstrenght contour of SVN 165 frequency block

Croatia	Italia	Austria	Hungary
HRV 5	Piemonte VHF	Niederoestereich	Hngcentre
	Trentino VHF	Salzburg	
	Toscana VHF		
	Abruzzo VHF		
	Basilicata VHF		

Sardegna VHF		

Table 1: Usage of Block 12B

Both solutions are in fact a modifications of allotments. The area of an Allotment may be modified without coordination only if :

- the same T-DAB block is used
- the Allotment area remains within the interference contour layed down in the Plan
- it is not intended to change the interference contour

In our case the same T-DAB block is used and further coordination with administrations is not required if the Allotment Area remains within the interference contour which can not be changed. In order to achieve this a special care shold be taken into account in planning the DAB transmitter sites and radiation pattern.

Using extending the allotments and splitting them into more entities it would be theoretically possible to locate all radio stations in the DAB system – yet, in the starting period at least, there is no space for new contents and services. The frequency spectrum will only be available after the period of transition from the analogue to the digital mode of transmission.

Along with the transition one should also contemplate the radio broadcasting pattern, or rather – would it not be necessary to co-ordinate radio networks with the regional spatial policy of the country. The present situation shows that the geography of radio networks disagrees with the image of statistical regions and actually forms its own spatial image. The process of transition into the digital world may be a suitable moment to decide whether to simply transfer the existing radio landscape into the digital domain or to draw a new spatial model of radio networks. The latter solution draws an advantage from the fact that all those stations which will use the same multiplex, will share the same territory, and thereby, the same potential audience. As for the contents also, multiplexes will need to be balanced.

2. TERRESTRIAL TELEVISION DVB-T

In the field of introducing a digital terrestrial television network DVB-T (Digital Video Broadcasting - Terrestrial) the conditions are even more complicated. During this year's Electronics Fair in Ljubljana the first DVB-T transmitter will start its trial operation from the transmission site on Krim. The operating European DVB-T networks transmit on available channels according to the currently still applicable plan, adopted in Stockholm in 1961, and amended in Chester in 1997. The new Planning Conference is anticipated to be held in 2005.

In Europe a rough estimate prevails, that each country would need 6 DBV-T multiplexes in MNF (Multi Frequency Network), which represents 6 UHF channels in order to ensure 95% coverage of the state territory [7, 8].

Factors which influence the planning of DVB-T

The parameters which influence the planning of DVB-T network and indirectly also the use of frequency spectrum are as follows [8]:

- DVB-T mode
- Selection of the length of »guard« interval
- Reception conditions (stationary, portable, mobile)
- Network type (SFN, MFN)
- Coverage (%)
- Networks (closed/open SFN, distances between transmission points...)
- Frequency ranges (UHF-Band IV and V, VHF-Band III)
- Number of multiplexes (depending on the scenario of DVB-T networks introduction)

Bad experiences in planning the terrestrial digital radio T-DAB are possibly the reason why a poll was carried out among users, which shows definite interest in the utilization of the new system in the following cases [7]:

- 80% for new services
- 67% for the operation of portable receivers (portability)
- 67% for interactivity

All three quoted statements directly influence the planning of DVB-T networks. From what has been said it derives that new services require more spectrum, as in the period of transition from the analogue to the digital system it is necessary to ensure the spectrum not only for the existing programmes but also for new services. The request for a good signal reception with portable receivers directly influences the selection of modulation procedure and the level of protection with channel coding.The interactivity clearly conditions the utilization of the return channel to the service provider, which is by all means a novelty in comparison with traditional radio broadcasting.

Mobility

The DVB-T system was not designed for mobile utilization. The Doppler effect, frequency and space dependent fading of a mobile channel, together with the phenomenon of a multitude of reflected and time delayed signals, can be successfully overcome only with the use of DVB-T/DQPSK mode. In this way it is possible to transfer approximately 6 Mbit/s in a 8MHz wide channel, which is much less than the rounded 22 Mbit/s, enabled by the use of 64QAM modulation in an equally wide channel.The possibility of reception of DVB-T signal in the mobile mode is nevertheless still a very topical issue, supported by European projects [9]. Through the use of an Improved Channel Estimation and of receivers with an implemented MRC (Maximum Ratio Combining) Antenna Diversity system a quality mobile reception of DVB-T is possible (8K, 16-QAM, r=2/3, Tg=1/4 (13,27 Mbit/s) and 8K, 64-QAM, r=1/2, Tg=1/4 (14.93 Mbit/s) [10]. Mobility is also very important because of non-television contents, as DVB-T apparently competes with the third generation mobile telephony.

Interactivity

It is obvious that another strong development orientation in the functionality of interactivity between the users and the content providers. It is possible that this very interactivity will be the characteristics, which – in addition to the possibility of mobile reception of signals of digital radio broadcasting networks – will be the driving force in the introduction of the new DVB-T network, which will attract the market mainly through new services and user friendly interfaces.

Standardization of the return channel

DVB-RCT (Return Channel Terrestrial) standard [11] is the newest in the family of DVB standards. Beforehand, the return channel standard in DVB-C (Cable) and DVB-S (Satellite) system were agreed upon, but the reason for the standardization of the return channel in the terrestrial system of digital television may also be searched for in the competitiveness of the third generation mobile telephony and in the fact that the investment in the construction of the return channel in DVB-T system has only be estimated at 10% of the entire share.

In planning of the return channel in DVB-T system we encounter the following difficulties:

- How to ensure a spectrum, used by the return channel? The width of the return channel is 1 MHz, and it is allocated in the part of the spectrum, used for DVB-T system. It is clear that additional needs for the spectrum are involved, which shall have to be co-ordinated at the future Planning Conference and considered in planning DVB-T networks.
- How does the introduction of the return channel influence the planning of networks? The introduction of the return channel also influences the planning of DVB-T network. DVB-T network can use the existing transmission sites, antenna towers and systems and the major part of the backbone network for the distribution of DVB signal. In such case the costs of mounting of a new network are correspondingly minor, while it also means that the radius of the area, covered by a single transmitter is typically 65 km. In this way it is possible to transmit a few kbit/s per each user. The deficiency of such a network is that, instead of a single transmitter, it is necessary to build approximately 28 transmitters on new transmission sites, naturally for the same area of coverage. This fact substantially rises the costs of such a network, and the claim that the introduction of the return channel RCT represents only 10% of the entire investment, stands no longer [12].

3. DIGITAL TV AND DIGITAL DIVIDE

Some people view DVB as a possibility for the decrease of the digital divide in the society.

»Digital interactive television may potentially provide access to the Internet to the poorer, less educated, the elderly and the other marginal social groups, and in this way may assist in eliminating the digital divide.« This is a quotation from the report, entitled »Understanding the Digital Divide«, published by OECD [13].

Convergent Networks

Digital television networks are becoming part of the family of convergent networks, typical of which is that the basic element of digital information is a bit, for which it is not important whether it represents a sound, image or data. In spite of merging capacity and compatibility telecommunication and broadcasting networks still greatly differ. Telecommunication networks are based on two-way communication between two points. The characteristic of broadcasting networks meanwhile is unidirectional communication from a single point to many. Various attempts of introducing new services are often misleading, as it seems that telecommunication networks can take over the role of broadcasting networks, and vice versa, which, naturally, is only possible along with great topology changes of the first and the latter.

For a better illustration of the above, let us quote an example of planning of the so-called broadcasting services, which enable the transmission of image and multimedia materials to the users of the third generation mobile networks. The service of the broadband communication is only possible for a single user in a telecommunication cell, which substantially differs from broadcasting systems.

On the other hand we are familiar with cases, when the broadcasting network is used for transmission of data to a single user. Here we speak about the transmission of coded contents through the broadcasting channel to the final user. For example, when a user orders his bank account statement by telephone, which he receives through the analogue teletext at his TV set. Such services are limited to a close circle of users, as the broadcasting operators are aware of the limitations, represented by the capacity of the broadcasting channel.

In short, limitations of the broadcasting systems, either analogue or digital, remain unchanged. These are the unidirectional characteristics of the communication model and the channel sharing among a great number of users. How do these two limitations influence the introduction of the access to the Internet, by means of digital TV sets?

The Internet communication is typically assymetrical, which means that the data flow from the network to the user is much greater than in the opposite direction. At first sight it may seem that, owing to their broadband characteristics, broadcasting networks are quite suitable for the access to the Internet.

The use of the Internet is a typical point to point communication. This applies equally to the receiving and sending of electronic mail, as well as to browsing on the Internet home pages.

The broadcasting network may serve as a downlink (forward) channel to the final user, who uses the telephone network for return channel. Digital TV channels provide approximately 24 Mbit/s channel for data transmission, which – at first sight – may seem a lot, if compared to the standard access to the Internet by means of telephone modems, which make possible the highest transmission speed of 56 kbit/s. But, a single broadcasting channel capacity is shared to many users. A simple calculation shows that a single TV transmitter, which broadcasts a programme, say, to a million people, and of these million users only one percent also demand access to the Internet, each of them will only get a channel of 2.4 kbit/s, which is obviously a very slow speed. Besides, in reality there are only a few broadcasting houses, which can afford to allocate the entire digital TV channel to the Internet service. Mostly, they allocate to the Internet only part of the capacity, typically 2 Mbit/s, which represents only a tenth of the above-mentioned value.

It is clear that we are dealing with the problem of data sharing betwen several users, which shall be taken into consideration when planning such services. This means that we can only discuss a limited offer of the Internet through broadcasting systems. Such contents shall be browsed, which is common to the greatest number of people. Once it has been defined, we can transmit it through the network only as a carousel, which means that we transmit the entire contents of the Internet page to final users, say every 20 seconds. In the worst case the user may have to wait 20 seconds for the required information. It is obvious that we are talking about limited interactivity, which means that the user actually interact only with his receiver. This can provide functionality, which enables the storage of the entire contents of the carousel, which represents a shortened time of response to the request for certain contents. This function reminds us of the Super teletext service, while the contents of the pages is more voluminous, and in HTML format.

As mentioned above digital television will not provide full access to the Internet, as it is limited by the final number of the media adjusted website pages. We can say that we are talking about a slightly different teletext – its pages are similar to the Internet pages, while their functionality greatly reminds us of the experience we have with the teletext.

Naturally one has to decide whether this is a service, similar to the digital teletext or to the website page. In the latter case the contents, offered by the broadcasters on the Internet portal, shall be adjusted to certain limitations, conditioned by the resolution of the TV screen, and by the typical distance between the viewer and the TV set, which represents 6 times value of the height of TV picture. In addition, all those links and hyperlinks shall be removed and adjusted, which display the pages, not accessible through the digital TV set. Interactive television issues will be included in the new standard DVB-MHP, version 1.1, which is to add HTML functionality to the old DVB-MHP, version 1.0.

As for electronic mail we can say that digital television enables such service. The electronic mail does not condition the real time transmission, and a relatively narrow information channel is sufficient for the transfer. Mail traffic can be handled dynamically and mail can be forwarded at the time, when there are free communication capacities. Naturally one can only receive messages with limited contents through the digital TV set.

The user can also send electronic messages through the modem, installed in the digital TV set or in the set top box. Regardless of the limited functionality we are dealing with a service, which – through its accessibility – undoubtedly decreases the digital divide.

Digital television can not provide the entire functionality of the Internet, while it undoubtedly offers a suitable environment for the development of multimedia functionality of television programmes.

Therefore, in addition to the above-mentioned factors, new services are an important factor in planning the spectrum for digital broadcasting. Technical characteristics of the new systems and the contents, by considering planning documents for spatial development, which also includes the population settlement strategy not only at the national, but also at the regional level, are basic starting points for the elaboration of the strategy of digital radio and television introduction.

4. PLANNING DOCUMENT “SPACE 2020”

It is true that the planning documents of the Republic of Slovenia bring up the influence of the telecommunication system on spatial development. The document has been under way for some time now, and in the meantime the process of convergence of telecommunication networks has started to evolve in the area of technology. The possibilities, provided and opened by convergence networks have not yet been sufficiently treated in the planning documents. Besides, telecommunication networks have been treated globally, and individual impacts of backbone, access, wire, or wireless networks on space have not been specifically illustrated.

5. CONCLUSION

Through the digitalisation, broadcasting networks have become a part of the global information infrastructure, which is the basis of development of information society. Through the advanced technological development the broadcasting has achieved a turning point, which is much more complex than the transition to the stereo sound, or the implementation of the colour television signal.

The characteristics of the present transitional period can be summed up in the following statements:

- broadcasting is becoming bidirectional, which – to a certain extent - changes the traditional communication model in broadcasting,
- the number of free communication channels increases,
- digital broadcasting network makes possible to transmit – in addition to audiovisual programmes, intended for broadcasting – distribution to the final users – other communication services as well (access to the Internet, for example).

By introducing bidirectional communication, and with the increased number of communication channels, more specialized audio-visual programmes appear. This leads to the formation of more narrow groups of people with similar interests and demands, catered for by specialized programmes, which narrows the idea of broadcasting, used to deliver of audiovisual contents to the largest possible public. We also find out that the production of the contents, as for quantity, can not follow the increased communication capacities, which also reflects in the objectively lower quality of audiovisual programmes. Simultaneously, the particularisation of the programme offer, and the interactivity in the form of the so-called services on demand, in the form of audio/video applications, change the traditional role and the influence of the strongest electronic media – radiotelevision, which was imposed by means of a simple, but important mechanism of scheduling the events, which determines the order of treatment of topical events, and thus attributes to them a major or minor importance.

As a result of the changes, caused by the technological progress in the area of radio television programmes broadcasting, the spatial aspect of broadcasting networks is becoming more and more important. Multiplexing or association of several radio and television stations into uniform communication sets requires rethinking about the area of coverage with the broadcasting signal, which – ever since – shall be common for all programmes in the multiplex. The digitalisation of broadcasting systems meanwhile caused technological convergence of the recently separated telecommunication systems, and consequently also enabled the transmission of multimedia contents. This applies to the digital radio as well as to the digital television. Owing to its lower transmission capacities the radio is less interesting for multimedia utilization, but the digital television system already provides much higher transmission capacities. In planning of future systems the following questions will have to be answered:

- What will be the relation between radiotelevision programmes and other telecommunication services in the new, digital broadcasting network?
- In what way will the digital broadcasting multiplexes be composed, so that Slovenia will be covered by a spatially balanced regional and national signal? [14]
- How to best utilize the available frequency space?
- What will be the relationship to other providers of telecommunication services?

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