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SESSION BACKGROUND PAPER



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Moving from Analogue to Digital Terrestrial Broadcasting *Background Paper – Panel 6*

1. PURPOSE OF THIS PAPER

The transition from analogue to digital broadcasting represents a major challenge to governments, broadcasters, regulators and consumers. This paper provides an overview of the advantages of this transition and the challenges that will be encountered. The paper then goes on to describe factors that need to be considered in preparing a roadmap for the transition. The challenges are particularly burdensome for developing countries. Taking note of the efforts underway around the world and in the CIS in particular, the paper describes ITU's contribution– both in the areas of radio regulations and provision of development assistance.

2. CONTEXT AND ISSUES

The digital revolution has completely changed the nature of Information and Communication Technology (ICT) networks and services. It is also driving additional convergence of networks and services. The digitized telecommunication network (including the Internet) also provides voice and video services based on IP technologies.

Digitization and convergence have changed the nature of infrastructure and of services, and helped promote the new digital economy. They offer the potential to benefit people all over the world through the provision of distance learning, healthcare and trade. They can also contribute to improved productivity and overall economic development.

Within the broadcasting sector, satellites have already undergone a digital revolution – they provide hundreds of channels - with higher quality video and audio compared to the analogue service. Digitization is now moving into terrestrial broadcasting. With digitization, terrestrial broadcasters can provide a greater number of channels with higher quality within the same available bandwidth and also provide advanced applications such as interactivity and electronic programme guides to compete and

survive with other broadcasting media such as satellite, CATV and telecommunications in terms of number of programmes and quality¹.

Making the transition to digital broadcasting is a complex process. It affects all segments in the broadcasting value-chain - from content production through to transmission and reception, all of which require technical upgrading to support digital broadcasts. The transition represents far more than just a technological challenge. It also has major social, political and economic implications – for example, in the convergence of broadcasting and telecommunications will mean that previously distinct sectors can now provide the same services, while a multiplicity of programmes and content can result in social and political empowerment. The transition or switchover from analogue to digital techniques can take many routes, each with its own advantages and disadvantages in terms of timing, the players involved, and the degree of government intervention.

3. DIGITAL BROADCASTING: ADVANTAGES AND CHALLENGES

The advantages of digital broadcasting from the stand-point of technology, industry and policy can be summarized as follows:

- More programmes can be provided compared to analogue technology through the same bandwidth;
- Digital technology makes it possible to deliver content more efficiently and effectively;
- Viewers can be offered interactive services ranging from the provision of information to transaction services (such as television shopping, and banking, etc.);
- Improved high-quality video and audio programmes can be transmitted;
- More efficient use of spectrum is possible, compared to analogue TV;
- Radio frequency spectrum can be liberated and made available for other services - this is the commonly cited Digital Dividend, which can be used for additional TV services (free-to-air or pay-TV), HDTV services, wireless broadband communications and mobile communications; and
- As a result of convergence, broadcasting networks will be capable of providing services such as data-casting and Internet access etc., while other networks can provide broadcasting services such as video on demand and IPTV.

This transition process is vastly complex. It is not just a matter of technology - there are major challenges to be overcome to realize a smooth transition, such as²:

- Regulators: Regulators need to review the rights of the license condition including spectrum rights and broadcasting rights and to decide on various technological options such as transmission technology, TV presentation format, compression technology and simulcast policies. These include the duration of any simulcasting period and how to approach simulcasting – for example, whether through a

¹ In fact, the launch of digital terrestrial broadcasting has revived the terrestrial broadcasting in some developed countries. A new high quality multichannel service, often freely available, has helped the terrestrial broadcasting to compete with satellite and cable broadcasting services.

² Digital Switchover in Broadcasting (BIPE, 2002) p 23 and Report ITU-R BT. 2140, Transition from analogue to digital terrestrial broadcasting (ITU, 2008) p 6-7.

phased or national approach. Regulators also need to develop spectrum policy on where and for which services the digital dividend can be re-allocated and to modify national frequency plans to meet the increased needs during simulcast period.

- Operators: Operators need to decide network planning options such as Multi-Frequency Network (MFN)³ and Single-Frequency Network (SFN)⁴ and identify key applications.
- Consumers: Consumers need to replace their current analogue equipment (main television, secondary televisions and video-recorders) with digital receivers.

4. ITU ACTIVITIES AND CURRENT STATUS OF TRANSITION

a) ITU Activities

ITU has undertaken several activities towards promoting the transition from analogue to digital broadcasting.

The Regional Radiocommunication Conferences held in 2004 and 2006 (RRC-04, and RRC-06 Geneva) approved the Regional Agreement for Region 1 and Iran (CIS countries are part of this planning area), which includes frequency plans for digital terrestrial broadcasting (in the GE06 Plan)⁵. These Plans should be implemented by 17 June 2015, with exception of some developing countries⁶, for which the transition period shall end on 17 June 2020.

In accordance with RRC-06 decisions, the ITU Radiocommunication Bureau (BR) has developed a special software package for compatibility analysis of frequency assignment/allotments in GE06 frequency bands. BR has assisted ITU Member States in their implementation of the GE06 Plan in a practical manner by analyzing the submitted assignments, determining coordination requirements, and assisting in coordination and modifying the GE06 Plan accordingly.

Given the complexity and costs of transition for digital broadcasting, ITU Radiocommunication Study Groups are carrying out studies and developing ITU-R Recommendations, Reports and Handbooks on the use of digital technologies for broadcasting and other services as well as guidelines on the switchover process.

ITU's Telecommunication Development Bureau (BDT) has initiated a project for developing guidelines for transition. These guidelines will be ready by the end of 2009 and will be made available on the ITU website. BDT provides assistance to Member

³ Multi-Frequency Network: the network of transmitting stations using several RF channels.

⁴ Single-Frequency Network: the network of synchronized transmitting stations radiating identical signals in the same radio-frequency (RF) channel.

⁵ Final Acts of the Regional Radiocommunication Conference for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz (RRC-06), see at: <http://www.itu.int/publ/R-ACT-RRC/en>. At RRC-06 every CIS country obtained at least 7 layers at every point of national territory. If all are used every viewer may receive from 28 to 42 standard definition TV programmes if DVB-T and Rec. ITU-T H.262 (MPEG-2) standards are employed and from 42 to 70 in case of DVB-T2 and Rec. ITU-T H.264 (MPEG-4).

⁶ The countries are listed in the footnote 7 of article 12 of GE 06 Agreement and all CIS countries are required to complete the transition by 17 June 2015.

States in developing their roadmaps. BDT also provided assistance to the Kyrgyz Republic to create an interactive multimedia broadcasting network for mountainous terrain.⁷

b) Current Status of Transition

A number of countries have already completed the transition, while others have already embarked on the process. A sizeable number have not yet prepared for the transition.

Finland, Germany, The Netherlands, Sweden, Switzerland and USA are among those who have already completed the transition. Among CIS countries, nine countries (Armenia, Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Ukraine and Uzbekistan) have moved to the transitional stage and four countries (Azerbaijan, Belarus, the Russian Federation, Ukraine) have developed their own plans for the transition.

5. THE WAY FORWARD

The transition to digital broadcasting is a complex process, requiring the involvement of and cooperation among legislators, regulators, broadcasting companies (content producers, broadcasters and network operators), manufacturers and viewers. Countries need to take decisions on the key political and technological issues, based on technical and economic analyses, the availability of relevant devices and equipment and the readiness of the viewers, whilst taking into account the relevant international regulations such as ITU Radio Regulations and regional and bilateral commitments. To overcome these challenges and to migrate to digital broadcasting requires adept policy and regulatory measures and careful choice of technologies, whilst considering the effect on end-users, particularly the poorer sections of the population.

a) Selection of Standards

Standards are essential to achieve interoperability and economies. The main issues of standards relate to transmission technology, TV presentation formats such as Standard Definition Television (SDTV) and High-Definition Television (HDTV), and compression technology. In most cases, regulators can strike a balance by not prescribing or recommending standards for all system/network elements, but only for selected elements. Some of the associated standards include:

Transmission Technologies: The GE06 Agreement is based on the T-DAB (for sound broadcasting) and DVB-T (for TV broadcasting) standards. A new version of transmission standard, DVB-T2 has been developed, with efficiencies of between 30-50% in its use of spectrum compared to DVB-T.

⁷ The project in Kyrgyzstan is to enable access to modern info-communication services based on modern interactive multimedia broadcasting systems for the people living in the mountainous terrain by providing a terrestrial digital broadcasting station, digital transmission link between digital studio and digital transmitter station, digital studio equipments and facilities.

TV Presentation Formats: SDTV can provide more programmes than HDTV in the same frequency channel/bandwidth, while HDTV provides higher quality video and audio programmes. The choice of the video bit rate for SDTV and HDTV services is a trade-off between picture quality and multiplex capacity. HDTV services are attracting considerable attention worldwide and are expected soon to become the norm for television viewing⁸.

Compression System: Currently the main choice for a compression system is the choice between Recommendations ITU-T H.262 (MPEG-2) and H.264 (MPEG-4). New compression systems are not backwards-compatible with existing systems, but receivers with the improved system can normally receive the old system as well. ITU-T Recommendation H.264 (MPEG-4) provides a coding efficiency of at least 1.5 times that of ITU-T Recommendation H.262 (MPEG-2) and further improvements are expected.

In many cases, the choice of standards is dictated by the requirements for TV picture quality and/or amount of data to be delivered⁹. It is common practice to use ITU-T Recommendation H.264 (MPEG-4) for HDTV. Many countries which have started (or completed) digital switchover use ITU-T Recommendation H.262 (MPEG-2) for the transmission of SDTV.

b) Licensing

A licensing framework for Digital Terrestrial Television (DTTV) comprises the assignment of three sets of rights (and obligations): spectrum rights, broadcasting rights and operating rights. Compared to an analogue television service, the digital value chain has an extra function - that of multiplex operator. The ownership and assignment of resources of the multiplex is crucial, because multiple programmes or services can be carried on one multiplex.

Regulators can balance the importance of these rights in different ways, so the applied licensing framework for DTTB has tended to vary from country to country and comes in many different forms and definitions. The following underlying factors can be identified for having different licensing frameworks: spectrum management objectives; competition rules and objectives; market structure and environmental objectives; media rules and objectives; and convergence trends.

c) Frequency Assignment

⁸ Recommendation ITU-R BT.709 "Parameter values for the HDTV standards for production and international programme exchange" approved in 1988 sought to help manufacturers and broadcasters in the move towards to HDTV.

⁹ GE06 Plan GE06 agreement is based on application of the DVB-T transmission and Recommendation ITU-T H.262 (MPEG-2) compression standards. This combination allows the transmission of 4-6 SDTV programmes in a single 8 MHz frequency channel. Application of DVB-T2 and Recommendation ITU-T H.264 (MPEG-4) standards increases number of SDTV programmes in one channel to 6-10. The same coefficient is applicable for HDTV.

ITU's Radio Regulations (RR) comprise an international treaty providing the basic framework for the global management of the radio-frequency spectrum¹⁰. In defining and planning the spectrum for digital broadcasting, regulators should take into account the RR and GE06 Plan.

In frequency planning, one of the most important decisions to take is about the choice of network architectures to be employed. It could be either SFN or MFN or a combination of Single Frequency Networks (SFN) and Multi-Frequency Networks (MFN). The opportunity to use SFN is one of the major benefits of digital broadcasting, as SFN can cover big areas using only one frequency channel. SFN is more spectrum-efficient than MFN. However, planning of an SFN is by no means trivial. SFN requires the synchronization of transmitters and monitoring (simple equipment can be employed). In the case of erroneous synchronisation, the network will be prone to self-interference. MFN is easier to plan, but requires greater radio-frequency spectrum resources. As a result, more radio-frequency channels would be used, but fewer broadcasting programmes could be delivered to the consumers.

d) Digital Dividend

The Digital Dividend can be defined as the spectrum made available after the digital switchover, over and above the spectrum that is required to accommodate the existing analogue television services. It is expected to be fully realized only after the complete switch-off of analogue television. How much spectrum is precisely used for these broadcast categories depends on many local factors, but most notably, the use of SFN or MFN, the applied modulation/required robustness of the signal, the required bit rate per service and the applied compression technology. The actual bandwidth of digital dividend will vary from country to country and depends on the regulators' objectives.

e) Analogue Switch-Off (ASO)

To complete the transition from analogue to digital broadcasting, analogue television broadcasts have to be switched off and the existing analogue services moved to a DTTB platform in a coordinated manner, led by the national government. The key element for the Analogue Switch-Off (ASO) process to be initiated is that the government should set a clear mandatory date for analogue switch-off.

Simulcasting Policy: There are two basic models of ASO: i) a national approach to analogue switch-off, whereby analogue broadcasting is ended simultaneously across the whole country when planners provided digital broadcasting to majority of population and ii) a phased approach, whereby analogue broadcasting is ended region by region.

The phased approach provides the following benefits:

¹⁰ In addition to the RR, the ITU framework for spectrum management also comprises the Constitution and Convention, stipulating the organizational and administrative procedures and rules between ITU Member States. For more detailed information, see report ITU-R SM.2093, "Guidance on the regulatory framework for national spectrum management".

- DTTB planners can apply the lessons learned in one region to improve and streamline the process in another region. Should something go wrong after analogue switch-off, the 'damage' is limited to a single region;
- The released frequencies can be re-used in neighboring regions in order to increase its DTTB coverage and expand the DTTB service offering;
- DTTB planners are able to spread investments over a period of time, thus maximizing the efficiency of resources and minimizing the risk. This will also minimize the risk.

Policy measures to ensure continuation of services for all viewers: Promoting the transfer of users to digital broadcasting is a central issue. If the switchover results in some sections of the population being deprived of broadcasting services, it will have serious social implications and will in general be going against the policies of many governments. It is therefore important that attention is paid to this aspect, through incentives such as subsidies and provision of information.

6. CONCLUSIONS AND RECOMMENDATIONS

ITU's Radio Regulations and the Regional Agreement GE06 provide a firm international regulatory basis for the transition from analogue to digital broadcasting. Equally, ITU is well-placed to assist in the implementation of GE06 Plan.

To conclude, some common key factors driving a successful transition can be recommended to countries which are embarking on the process of transition to digital broadcasting:

- A successful digital switchover and analogue switch-off (DSO/ASO) will require the active participation of, and coordination between, the Government and the television industry. Only by working with Government and the regulator can the broadcast industry ensure a minimum amount of disruption for viewers;
- The decision to stop analogue television services needs strong leadership to affirm when and how the analogue switch-off will proceed and define a clear roadmap. This can provide credibility to the process and help avoid unnecessary delays; and
- Viewers need to have access to sufficient information in a timely fashion, including: why the DSO/ASO process is planned and what the benefits will be; the availability of alternative television platforms; the date when the analogue terrestrial television will end; new equipment needed; and finally the costs associated with receiving digital television programmes.