Eurovision Network Management System – the ENMS

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A characteristic of Eurovision operations, as the network has expanded and evolved over the past 40 years, has been the sustaining influence of a club spirit, founded on the exchange not only of programe material but also of mutual support, technical assistance and a certain degree of altruism. Although only recently identified as a potential target for improvements, the Eurovision Network Management System has always existed, albeit heavily disguised as an ability to adapt to circumstances, and it has always been dependent on the expert knowledge and the professional skills of the people who have made Eurovision work.

The article explores some of the concepts being considered for a more formal approach to Eurovision network management, adapted to the specific operational and commercial requirements of today – yet remaining respectful of the long-standing Eurovision tradition of solidarity and collaboration.

1. Introduction

The Eurovision programme exchange has now been operating for some 40 years, and it has never been more intensively used than at present. Running the exchanges and the network on which the television programmes are transmitted is a demanding task which has been performed with the extraordinary goodwill and diligence that are the hall-marks of the the Eurovision community of managers, planners, technicians, engineers and programme makers. Management of the network has been the responsibility of the EBU Technical Department which was initially situated in Brussels, and since 1989, in Geneva.

Eurovision network management has always been a very human affair in that it has involved *people* dealing with the requirements of operations, circuit maintenance, logging and billing of circuit use, and network planning and evolution.

This "hands-on" management has in no small way imbued the Eurovision network with an approachable, human character with few mysteries for users other than perhaps getting to grips with

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the acronyms used as shorthand in the transmission synopses that are distributed to all participants in programme exchanges. Of course computers, faxes and databases have been brought into play to simplify and speed up certain areas of the management process, but the basic organization is still a human one.

Almost inevitably this management era is fast coming to a close. Increasing volumes of traffic, greater transmission complexity and the ever-present requirement to improve productivity will ensure the demise of the present order. Technological and regulatory changes in the modern telecommunications scene give ample opportunity for the development of a new approach to EBU network management. It will nonetheless demand particular skill to develop a forward-looking management system for Eurovision that does not alienate its users by dehumanising the network and the programme exchanges, yet reduces the inefficiencies that currently exist in the overall system.

Like many new ideas, the first concrete evidence of their existence is a name and an acronym. The first real evidence of the EBU's attachment to the principles of advanced network management is called "Eurovision Network Management System - ENMS".

2. Operational expectations of an ENMS

A complex programme exchange system such as Eurovision (or Euroradio) can broadly be considered in terms of four core functions:

Operations

The EBU employs around sixty personnel who are directly involved with the day to day technical running of the Eurovision network. About half of these are employed in the EVC (Eurovision Control Centre) in real-time network coordination. About one third are concerned with network planning, whilst the remainder take care of technical developments, quality control and management.

The EVC is the operational hub of the Eurovision network, which keeps in constant touch with all the national technical control centres (CNCTs). These provide the technical interface between the Eurovision network and the national broadcasters.

Planning

Whilst the operations function is perhaps the part of the management process which lies closest to the hearts of the many television and telecommunications engineers active in the Eurovision environment, proper functioning of the network is irrevocably dependent on the planning function. Briefly, planning aims to ensure that all network facilities - satellites, earth stations, terrrestrial links, standards converters and the like - are booked in a timely and cost-effective manner, regardless of the advance warning (which may vary from several years in the case of major sports events to just a few minutes for a fast-breaking news story).

Billing

The over-riding thing to appreciate about billing functions in the Eurovision network is that they are most complex, (almost a black art!), and can well use any degree of automation available to make them more manageable. The billing process attempts to limit the actual transfer of funds from country to country in payment of the network's use, a practice which would enrich no-one except the banks, and so it introduces a concept of "clearing" transactions (i.e. transmissions) in kind throughout the Membership of the EBU - one more example of the working of reciprocity between EBU broadcasters.

One of the complications in costing transmissions is that the amount of time a circuit is used for a transmission can often bear little relationship to the amount of time for which it was originally booked. Television transmissions are notorious for under- and over-running for an almost infinite variety of reasons, and Eurovision is run in as flexible a manner as possible to accommodate this fact of life.

To this end, the actual transmission timings are carefully noted, together with circuit utilisation timings. This data is collated in Geneva and, depending on the type of transmission (request unilateral and Eurovision multilateral being the two main categories), the cost is apportioned between the participants, as appropriate.

Use of the Eurovision network by broadcasters and other organizations which are not EBU members is a recently-introduced practice whose financial importance in support of the network is growing. Clearly, billing in these cases cannot be based on any principle of reciprocity, and commercial factors and practices must be heeded and followed in this type of transaction. The EBU re-

cently appointed a commercial manager to oversee this aspect of Eurovision's business[1].

Maintenance

In its simplest sense, maintenance refers to repairing any equipment in the network that has broken down. This, of course, is done throughout the network daily by personnel employed directly by the EBU, by the EBU's Members, and by the PTTs and other carriers which actually provide the network infrastructure.

However, in a much wider sense, maintenance refers to the continual monitoring of equipment, circuits, planning and operation procedures, quality of service achieved and customer interactions, which all contribute to ensuring that Eurovision's clients, Member and non-member alike, receive the best technical transmission quality possible when and where it is needed and at the most appropriate cost to all concerned.

The management of these strongly inter-dependent but widely diverse functions has evolved over the years, largely as a sequence of reactions to specific problems caused by increases in traffic, the introduction of satellites, changes of television standards and transmission technologies, etc. Only recently has any real thought been given to the potential advantages of a more positive - a more "active" - approach to network management, leading to a more or less profound review of the way the network "works".

Inevitably, such a review will tend again to be oriented towards the solution of shortcomings in the present-day network management system. Evolution will continue to be the keyword, if only because a 40-year-old network on which millions of television viewers have, perhaps unknowingly, become largely dependent for their daily information and entertainment, cannot be re-built over-night. In the light of *today's* requirements, features of a new approach to network management should include:

- improved interfaces with users (Eurovision Members) and prospective users (third parties) of Eurovision facilities;
- real-time access to the current (and the planned future) status of the network, which will aid in avoiding traffic congestion and optimise system performance in general;
- more-adequately documented data for traffic and fault-reporting statistics, and for quotations and billing, leading to improved financial management of the system;
- the ability to accommodate the scrambling and conditional access requirements of satellite transmission;
- the ability to reconfigure the network even more rapidly than is currently possible (e.g. to respond to emergency news coverage, network breakdowns, crisis traffic etc...);

A common need that can be identified as a basis for providing all of the above improvements is that of *good communication throughout the Eurovision network*. Insofar as the ENMS can be identified with communication, and without forgetting that network management is - and will largely remain - a matter of human contact, it is fair to suggest that the ENMS will be materialized in the form of network(s) which will adequately support all the necessary voice and data communication needs of Eurovision.

3. The ENMS "network"

The ENMS will need to interact with all the nodal control facilities having access to the Eurovision network, and any other technical termination points existing in the network. Such facilities include the national control rooms of the EBU Members, the national technical coordination centres (CNCT's), satellite earth stations, programme origins and third party organizations. Whilst this interaction might appear rather simple in theory, the inherent diversity of network nodes will imply a need for a large number of interfaces between different physical equipments and different data protocols.

Whilst the EBU can try - with varying degrees of success - to standardize systems within its own Members' premises, it is not so clear how to ensure that the CNCTs can interface to the various voice and data communications circuits currently in use within Eurovision operations. Each CNCT is effectively unique: they are in different countries, they interface to different PTTs, they have been built throughout the past forty years, and each evolves independently under the control of an organization whose primary allegiance is not necessarily to the EBU.

One way of standardising voice and data delivery throughout the network would be to dispense with all the current terrestrial circuits and to migrate to a satellite system capable of delivering all neces-

1. See *page 41* of this issue of **EBU Technical Review**.

sary services through standardized terminals situated exactly where they are needed in the network - including not only fixed CNCTs but also occasional, mobile nodes such as outside broadcast installations. By using part of the satellite transmission capacity that is already being leased for Eurovision and Euroradio purposes, a saving could be realized on the cost of providing the bearer network.

A network based on Very Small Aperture Terminal (VSAT) satellite technology would appear to satisfy the above requirements and this solution is being very actively pursued in the EBU Technical Department[2*].

4. Changes having an influence on ENMS functions

The initiation of a project to establish an up-to-date ENMS does not in any way imply that its conceptors have any entirely free hand. They cannot "stop the clock" and they cannot impose change for change's sake. An awareness of the *raison d'être* and the constraints affecting each facet of network functionality must guide the ENMS designers towards rational, practical and, above all, cost-effective solutions. Some of the more important developments with which the ENMS must co-habit are considered in this *section*.

4.1. Planning and billing - the TPP

After several years of development work, the EBU has recently introduced a central computerized planning system, known as the "TPP"[3], at its Geneva headquarters. The TPP includes an interface to existing facilities for billing users of the network, and after all the effort that has gone into perfecting the TPP as a stand-alone system, the ENMS will need to interface to it with a minimum of change to its structure.

4.2. Maintenance and security of the television network infrastructure

The trend, since 1984, has been towards the intensification in the EBU's use of satellites to carry its Eurovision network. The mainstay of the network is one of the Eutelsat satellites on which the EBU leases permanent capacity. Occasional capacity is rented on other satellites as and when necessary, and there is also a pair of digital television channels carried on an Intelsat satellite which permanently link the EBU facilities in the United States to the main European network. The satellite network has progresed via several phases of expansion to include about 50 earth stations in the European Broadcasting Area[4] and this increasingly intensive use of satellite channels has an impact both on the maintenance and on the security aspects of network management.

4.3. Maintenance

Maintenance of the terrestrial circuits which still constitute an important part of the network is the responsibility of the PTTs from which the circuits are leased. The work needed to liaise with the PTTs to ensure this maintenance is performed by the EBU Members at their CNCTs. This sort of piecemeal international maintenance is a major preoccupation, and the use of satellites can greatly simplify this as the satellite operator is the single point of contact for the space path, and maintenance of the earth stations is more directly under the control of the broadcasters on whose premises most of them are installed. Placing more and more dependence on a single transmission system does mean, however, that maintenance of earth stations must be done as rapidly as posisble and users throughout the network must be made aware of the operational status of all earth stations at all times.

4.4. Security

The use of satellite channels for the majority of Eurovision transmissions means that the confidentiality of the transmission is more difficult to guarantee. Satellite channels are inherently more susceptible to unauthorized access than are point-to-point terrestrial circuits.

The solution is to use signal scrambling, and a conditional access management system to confer a high level of security on satellite circuits.

In digital television transmission, the scrambling mechanism takes the form of a pseudo-random arithmetical manipulation of the bits into which the picture, sound and other signal elements are converted for transmission. The important feature of digital scrambling is that, unlike scrambling applied to analogue television signals, the recon-

2. See *page 19* of this issue of **EBU Technical Review**.

3. "Transmission Planning Procedures". See *page 26* of this issue of **EBU Technical Review**.

4. See *page 5* of this issue of **EBU Technical Review**.

stituted (i.e. descrambled) signal exhibits no scrambling artefacts or quality degradation. Digital scrambling only imposes an additional processing-time penalty on the signal, and a scrambled picture takes longer to transmit from the source to the destination than an equivalent picture transmitted "in-the-clear".

A conditional access (CA) management system is needed to operate alongside a scrambling system so that the organizations authorized to receive a particular television transmission can actually decode the signals relevant to them. CA management is inherently part of the ENMS, and it will also require the use of a data network interconnecting the CA authorization centre in the network to all of the digital encoders and decoders being used for Eurovision.

5. Features of the ENMS CA management system

5.1. Concepts and constraints

Conditional access is most often encountered in a pay-TV broadcast environment, where all of the scrambled programme streams originate from, or at least pass through, a single transmission point. This point may be a satellite uplink antenna farm (or "teleport") at which point the encrypted conditional access data, needed at the destinations to permit access to the programme material, is combined with the signal for transmission to air. At the receivers, this CA information interacts with the subscribers' decoder (through a smart card, smart key, or perhaps an embedded security chip inside the receiver) to allow desrambling of the programme material.

In this sitiation, the CA data is effectively carried in a star network, with a central transmission point and multiple reception points. All CA information flows out from the transmitter along with the programme material, and it contains all the addressing information to enable descrambling at every authorized reception point in the programme target area.

The CA requirement for Eurovision is quite different, and is much more complex than the broadcast scenario outlined above.

There are about 50 earth stations in the Eurovision network and each of them has two transmission chains and four reception chains installed. In addition to these "Eurovision" earth stations there is an increasing number of television receive-only earth stations (TVRO) being operated by Members and non-members alike for the reception of transmissions via the EBU-leased Eutelsat transponders.

There is no unique, centralising transmit location within the Eurovision network corresponding to the centre of a pay-TV star network. Any network node or transmission terminal - including fixed or mobile earth stations - that has transmit capability to EBU leased capacity must be thought of as a source of programme, functioning, for the duration of the current transmission, as the centre of the CA data star.

Most CNCTs in the Eurovision network will have access to several digital television encoders and decoders. Ideally, individual encoders and decoders might be permanently assigned to given transmission/reception chains and satellite channels in each CNCT, but this is unlikely to be the case if most efficient use is to be made of the equipment, and capital expenditure in the network is to be minimized; even if equipment was in principle allocated permanently to specific circuits, there would inevitably be exceptions for transmission overruns, equipment breakdowns, short notice requirements, etc..

It is commom practice - if not actually the normal situation - for the Eurovision network to carry simultaneous transmission of different programmes on different satellite channels. The number of digital television transmission channels carried in the EBU leased satellite capacity will be between six and thirty-two, depending on the channel bit-rates that are chosen, and on the allocation of channels at different bit-rates in the satellite transponders.

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In 1988 he joined the EBU Technical Department where, as an engineer in the Transmission Sector, he participated in the original RACE programme of the European Union and was involved in the standardization of component digital television transmission codecs operating at 34 Mbit/s, within both the ITU and ETSI. The ENMS concept arose from work done within EBU Sub-group T3 (Video development).

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Eurovision transmissions can have durations of a few tens of seconds up to tens of hours, and in order that the network is operated cost-effectively, switching between sources and satellite channels must be done very quickly.

The notice available to the network planners of transmissions can vary from several months for events such as the Olympics, to barely two or three minutes for news stories, and it is only these network planners who really know who is participating in what transmission, which organization has the right to receive what portion of the transmission, etc..

5.2. Possible CA scenario for Eurovision

Consideration of these constraints leads to the conclusion that there must be an ENMS CA Coordination Centre (ECCC) in the Eurovision network which works closely with the Eurovision Planning, and that this ECCC must be able to communicate with all of the digital television encoders in the network. Although, in principle, this Centre might be located anywhere, for logistic reasons is would be sensible to locate it at EBU Headquarters in Geneva.

For each transmission, the ECCC must load the transmission encoder with a set of authorizations corresponding to all of the decoders participating in the transmission it will be originating. However, only the source CNCT can know which of its digital encoders will be connected to the satellite channel chosen to carry the transmission. For this reason, all encoders at a CNCT will need to be connected to a local data bus, having common access to the CA data network, so that all can receive common CA data from the ECCC.

To ensure that only the correct encoder (and not all encoders on the data bus) is addressed for the transmission in question, the CNCT will need to load a temporary "identity" into the correct encoder when it is selected into the transmission chain. The simplest and most universally distributed identity, that is used for each transmission in Eurovision is its synopsis number. (The synposis is a summary of all technical and programming information concernning a specific transmission, which is distributed to all parties involved prior to the start of transmission.).

The operational overhead of awarding each encoder a synopsis number prior to an encrypted transmission could be minimized by using an appropriate interface, and could even perhaps be embedded within the general selection process of placing the encoder within the correct transmission chain for a transmission.

The CA messages generated by the ECCC could either be sent cyclically, with an active window encompassing some minutes prior to and after the planned start time of a transmission, or they could be demand-assigned from the source CNCT; the choice would depend on the exact topography and data organization of the CA data network implemented.

As in the case of broadcast CA, the transmission encoder will transmit all the relevant CA information necessary to enable reception by the receiving services over-the-air, using the ancillary data capacity generally available in television codecs (i.e. the authorization becomes part of the television transmission itself).

For reasons of operational convenience, all decoders at each CNCT will need a common identity, so that addressing a destination will authorise any decoder that is across the transmission circuit at the destination CNCT.

It is important to appreciate that the security afforded by signal scrambling and conditional access ceases at the points where the signal is decoded in the receiving services' control rooms. From these points onwards, responsibility for the security of the signal is in the hands of the receiving services.

6. Building the ENMS

In a sense, the ENMS has been in existence since the day Eurovision commenced, but it was not given a name. As transmission technologies develop and migrate from one form of support to another, and as the need for optimum efficiency in the exploitation of the investments made in Eurovision by its Members grows more crucial, so will the ENMS need to be adapted and expanded.

We noted at the beginning of this article that the new concept now has a name - and even an acronym. It is gaining an awareness of its potential as a tool for generalized efficiency improvement throughout the Eurovision network, and is in the process of establishing objectives. In the relatively short-term future it will have a dedicated communications channel. In the medium-term it will have to start earning its keep .....