International Dimensions of Cable Television

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ABSTRACT

This paper will discuss current activity in Cable TV in several countries in Western Europe and other areas. Based on the author's personal experience, the following topics will be included:

* Current State of the Art of European Cable.
* Differences in system configuration (ie. switched star in United Kingdom systems)
* Technical comparison of European and American systems
* Technical considerations for European applications.
* European construction methods and approximate costs.
* Labor and training requirements.
* Operational considerations (importing, taxes, rate of exchange problems, billing systems).

A discussion of the future potential of CATV in Europe will include recent developments in DBS, HDTV and fiber applications.

CURRENT STATE OF THE ART

The widespread use of Cable TV as a delivery medium is a relatively recent development in Europe. Cable has been available in some countries, such as Ireland, for many years but only in the past two years has Cable really become viable in most of the European area. The reasons behind this change are somewhat complex and can have an effect on the type of system which is required in a particular country. Whatever the motivation behind the change, the fact is that Cable is becoming an increasingly visible medium in many areas around the world.

Existing systems range from very small SMATV type applications to large city size systems with most of the bells and whistles associated with modern American plants. Systems carry anything from two or three channels up to forty. Newer plants are being designed with bandwidths of from 450 to 860 MHz. European operators take full advantage of the technical advances which have been made in the U.S. and Canada over the past twenty years and managed to avoid a good number of the mistakes domestic Cable operators had to struggle with as CATV developed here. This, of course, is a tremendous advantage as new systems come on line and programming choices increase.

An important consideration in any foreign country is the perception of television by the residents. It must be pointed out that in many countries TV has been a State owned or State controlled medium. Reception in a lot of nations has been limited to only one or two channels for many years. As a result, the people who live there do not always perceive a need for additional television programming. Many times they cannot conceive of how they might be able to use more than a half dozen or so channels. Beyond this, there is a vast difference in the way Americans and Europeans use TV. Here in the U.s. we are conditioned to having a large number of channels twenty-four hours a day, even in areas not served by Cable. We are also quite used to being entertained by television and most Americans also rely on TV as their primary source of news. In the main, though, it is the way TV is perceived as a method of recreation in America that sets us apart from Europe. European subscribers are, at first, a little stunned by the sheer number of programming choices they suddenly have after decades of having only one or two channels. They literally do not know how to take advantage of Cable. It thus becomes part of the operator's job to educate the subscribers in this regard.

One of the most dramatic recent changes in the European situation is the advent of satellite delivered programming. Similar to American Cable systems, the introduction of additional programming has been the key element in fostering the growth of Cable. For the first time, system operators can offer product beyond the available off-air channels and locally produced efforts. Further increases in satellite capacity are planned and the addition of still more channels will give another boost to Cable in Europe.

To summarize the current situation in Europe, and other areas of the world as well, one would see a wide mix of old and new technologies operating in almost every imaginable configuration. Increases in available programming and the use of both American and Continental electronics has brought about changes which will drive the existing systems to become more like their American counterparts, in function if not in form. Cable in Europe can be compared to the industry as it existed in the States back in the early seventies, just on the verge of explosive growth in both system size and area coverage.

SYSTEM CONFIGURATIONS

There are three basic system configurations in use in the European plants. These are tree and branch, switched star and a variation of the switched star which is built in the star architecture but does not employ active switches at the node points. Again, government regulations have a great deal to do with the type of plant configuration which is employed in specific areas. Beyond this, the density of the housing and existing infra-structure are determining factors in how systems are designed and built.

Some countries, most notably the United Kingdom, actively promote the use of one configuration over another. The reasons for this can range from the pragmatic to a reliance on what outside "experts" have claimed to be the best system architecture. In the specific case of Great Britain, as an example, the story started with British Telecom (BT), the government owned telephone company. As part of a growing trend in Europe, the British decided to denationalize the phone company and let it compete on the free market as an independent entity.

At the same time, however, the government decided that there was a need for something for the BT to compete with. Thus, they created a structure governing the development of alternate telecommunications systems such as Cable TV. The idea behind all of this is to foster the growth of independent systems which can compete with the phone company and avoid monopoly control of communications within the country. In their desire to promote alternatives to BT and to avoid the situation where only TV service is being offered, the governing rules are structured so as to promote the use of a switched star type system. The hope being that operators will eventually offer services other than just television such as telephony, data communications and so forth. The incentive for this is an eight year extension to the fifteen year license, or franchise, for operators who build and active, switched system.

The switched star configuration, for those not familiar with it, is based on the use of neighborhood nodes which feed the subscribers. This is similar in configuration to the off-premise converter systems which have been tried in the States but with more capacity. Again, the intent of the regulators is to encourage the type of system architecture which will facilitate active telecommunications services beyond television delivery.

Systems built in the star configuration, whether switched or not, offer a great deal of flexibility to the operator and can, if properly built and maintained, provide an extremely reliable plant.

The other factors mentioned, density and existing infrastructure, also have a good deal to do with the final build structure. Densities in many areas of Europe are quite high when compared to the States. Homes passed on a per mile basis can often exceed three hundred and in some instances be in the neighborhood of one thousand or even more. It should be noted that per mile comparisons can be somewhat misleading in the cases where star configured plant is being used. Star systems have about thirty percent less active plant than tree and branch topology so per mile figures are skewed upwards. However, the fact remains that the overall densities are quite high when compared to most American systems. The star configuration is particularly well suited to very high density situations, especially when the vast majority of construction is extremely expensive underground build. For example, let us say we will install nodes so that, on average, there is one node per two blocks of houses. This can be visualized by imagining a capital H with the node at the center of the crossbar. The legs of the H represent the drops which run down the streets past the homes. In this configuration there is only one pedestal or cabinet, which houses the node equipment. The bulk of the plant is conduit for future drop feeds. There is no need to install taps and pedestals at many locations and expensive street crossings are minimized. There are problems with this approach too, subscriber installations become more difficult and time consuming for instance, but overall the star configuration is a very efficient method of serving high density areas.

The existence or non-existence of usable conduit, the complexity and location of the other utilities and the accuracy of underground structure maps also contribute to the determination of how a plant is built. In most of the areas that this author has seen all of the services, electric, phone, gas, etc., have been one hundred percent underground. There are exceptions to this but they are rare and in any case, all new service is required to be underground anyway. Because the existing infra-structure has been in place for a very long time and has been rebuilt, modified and changed along the way, it is not unusual to find that there are no records which will allow the operator to determine exact locations for the existing services. In some instances this is complicated by the fact that many service feeds, even natural gas, are enclosed in plastic pipe which means metal detectors are useless for locating underground structure. It may be that the best an operator can do is determine that phone and power are both on one side of the street, in which case he can build on the other side. The location of the other utilities is even partially known, can be the deciding factor in determining where CATV facilities need to be placed and thus become the ultimate method of fixing on a system architecture.

In other areas, notably, Sweden, the topography and demographics of the cities themselves will determine how a system must be constructed. Many Swedish cities consist of large areas of MDU's, sometimes three or four thousand units, separated by relatively small areas of single family dwellings. In these cases the structure of the system will be determined by the most efficient method of reaching the greatest number of passings, the MDU's and picking up the rest later. This can lead to plants with fairly long supertrunk runs followed by relatively short feeder systems supplying signal to a small area with a large number of dwelling units. This kind of layout falls naturally into a tree and branch type of design for the system backbone.

The MDU's are fed from centralized splitter locations, a type of star configuration. Television drop wiring is in place in most of these large apartment buildings in internal conduit systems. The normal method of connecting the units is a loop system, where each unit is connected in series, rather than individual homerun type drops. This can impose limits on the options available to the operator to provide tiered service levels and/or pay channels. Because of government regulations requiring that each unit be able to receive the National channels, the operator is usually faced with providing a universal service to all dwellings programming as well.

One other unusual aspect, at least to most American engineers, is the way systems are defined by layers or networks. The best analogy to describe this feature is to use typical U.s. terminology to illustrate the different plant categories. Typically, a European plant is described as being composed of three separate networks called D-1, D-2 and D-32, plus the headend and hubs. (In some areas the headend itself is considered a distinct layer of the system and supertrunk or other interconnect methods can constitute an additional layer. The most common description is for three layers). The D-1 network is roughly analogous to the main trunk system in a U.S. system. The D-2 network can be compared to the feeder system, and the D-3 net is the subscriber system. There are specific points identified as being the turnover spot between networks. The most important issue here is that in many countries, Sweden is a good example, the D-3 net is owned by the subscriber, not by the Cable operator. The operator is responsible for the signals only up to the point at which they are placed on the D-3 net. It is interesting to note that the subscribers usually have to pay for the D-3 net themselves. The fact that the subscribers (or apartment house owners) own the final part of the system is another limiting factor in Cable design in Europe.

TECHNICAL COMPARISON OF EUROPEAN AND AMERICAN SYSTEMS

There are very few countries outside of North and South America which use the NTSC system of television transmission. Most European and Middle East countries have adopted either the PAL (Phase Alternation Line) or SECAM (Sequential with Memory) systems. The PAL system utilizes 625 lines interlaced two to one at a rate of fifty fields per second. It uses a four to three aspect ration and the sound carrier is the same as NTSC. Most commonly, PAL signals are either seven or eight MHz wide, depending on frequency. PAL and SECAM systems differ mainly in the way color signals are processed. Both systems are alike in that they separate the chrominance and luminance information and transmit the chrominance information in the form of two color difference signals which are used to modulate a color sub-carrier which is transmitted within the bandwidth of the luminance signal. In the PAL way of doing thins, the phase of the color sub-carrier is changed from line to line. This necessitates sending a line switching signal along with a color burst. In the SECAM system, the color subcarrier is frequency modulated, alternately, by the color difference signals. This also requires the inclusion of a line switching signal within the channel. Both of these systems produce picture quality which, as a rule, is superior to that of the NTSC signal. Signals in many areas also include teletext information in the vertical interval.

The main difference as far as Cable is concerned is the wider bandwidths of European signals. As a general rule (although this is not entirely accurate) channels at lower frequencies, comparable to the VHF band, are 7 MHz wide. Higher frequency channels, UHF band, are 8 MHz wide. There are five bands of broadcast signals arranged to include both TV and FM radio signals. Band I goes from 41 to 68 MHz, Band II from 87.5 to 100 MHz (FM radio), Band III which goes from 582 to 960 MHz. Cable systems utilize bandwidths starting at 40 to 50 MHz and extending to 450 or 550 MHz. There are some cable systems which have been designed to operate up to 860 MHz but these are the exception.

Both VHF and UHF frequencies are utilized for broadcast, although in Great Britain only UHF is allowed. Because there were, until recently, only a few channels available most of the older TV sets are limited in the number of channels they can receive through their tuners. Newer sets, made in the last five years or so, can receive more.

The combination of UHF only reception and limited tuner capacity in the United Kingdom presents the Cable operator with the need to provide a UHF input signal to the receiver. In switched star systems this can be handled by either sending a low frequency UHF signal down the drop or by sending down a VHF signal and installing a VHF-UHF upconverter in the subscribers home. Systems which use converters must install an upconverter on the output of the box. The use of the upconverter is complicated by the fact the U.K. signals contain teletext information which must be delivered to the set in a usable state. The specifications of the upconverter are therefore fairly strict. The operators who have chosen to send UHF signals down the drop avoid the use of upconverters but find drop lengths limited by attenuation factors. This, in turn, can place restrictions on the node locations.

System operating specifications are generally comparable to those dictated by good engineering practices here in the States. Composite Triple Beat and CrossModulation are usually expected to be in the -53 or -54 dB range. Carrier to Nose is specified for a -44 to -46 ratio. Group delay, differential gain and differential phase, system response, hum modulation and other parameters are also very similar to U.S. standards. Some differences arise in radiation specifications, which tend to be a little stricter in Europe and in some specific areas such as port to port isolation in subscriber taps. Isolation requirements in some countries can place severe restrictions on the tap values available to the system designer and complicate amplifier placement and levels.

The other factor that must be included in considering the European systems is the layer or network distinctions. As noted above, the systems are often defined in specific networks. The operator must be aware that each portion of the network has its own related set of technical specifications. These standards are specific to each layer and are generally not additive. That is, the D-2 net is expected to meet certain criteria regardless of how the D-1 net is operating. The only point where a general set of spec's apply is at either the subscriber outlet or at the defined turnover point to the D-3 net.

In general, European technical specifications are reasonable and a well engineered system will meet these standards easily. The fact that there are fewer channels carried, due to the higher bandwidth per channel, means that engineers can define system specifications to run at the high levels necessary to meet noise and isolation regulations without running into severe distortion effects usually associated with high level operation. From an overall, technical standpoint, the European systems, if built according to the standards, will compare quite favorably with those in America.

TECHNICAL CONSIDERATIONS FOR EUROPEAN APPLICATIONS

As in any system, here in the States or overseas, the principles of solid, well understood engineering practices apply. Systems should be designed so that the end user receives the highest possible quality picture available. There should be extremely little or no degredation present and the system, taken as a whole, must have a very high degree of reliability.

European systems differ from their American counterparts in several areas. Governmental regulations apply one set of considerations to system design as noted previously. System topography, as dictated either by regulation or demographics, applies another layer of consideration. Local conditions, such as the UHF requirement in England, add yet another aspect to the whole situation.

A good example of the type of complexity that can arise from a combination of all of these factors may be illustrated by looking in detail at a typical application in Sweden. The example area is a group of MDU's numbering 2,000 units which will require about 4 km (2.5 miles) of plant to feed all the buildings. Construction must be done underground and the headend will be located within the complex. In this area, as in many areas in Sweden, there are three off-air channels available, all of which are must carries. There are also several satellite channels available, ranging from Russian broadcast TV to a French language channel and a couple of English language channels. The apartment owners recently (within the last two or three years) rewired all of the apartments in accordance to the Swedish regulations. The internal wiring, the D-3 net, is all looped from unit to unit with the feeds coming from the basement.

The operator wants to offer a basic tier of service, consisting of the three must carry channels, to all of the units. He also wants to offer a second tier, an expanded basic level, to subscribers willing to pay for it and a movie service. The headend and earth station installation will be fairly straight forward and familiar processes. The first decision comes in deciding which trunk cable to use. Swedish standards call for these cables to have a copper outer conductor and a solid copper center conductor. The reason for this requirement is the feeling on the part of the authorities that copper cable will not corrode as much as aluminum cable will in similar circumstances.

There are a number of cables available, commonly built in a fused disk construction. The next decision involves the routing of the D-1 and D-2 cables to feed the forty or so buildings in the complex. Strict attention must be paid to the spec's for each portion of the plant up to the point where it is turned over to the D-3 net. Most of this process is familiar CATV type engineering and design. However, once inside the buildings the differences become more significant. The typical subscriber outlet in use in Sweden contains an FM splitter so that there are actually two feeds into the apartment, one for TV and the other for radio. The drop, coming from the apartment or basement below, is connected to the outlet and then loops on the next apartment. Because of the FM trap it will be difficult to use an American type addressable converter which, typically, needs data which is carried in the FM band, the data will have trapped out before it can reach the box. Likewise, traps present problems. Negative traps, which might be used to protect the upper tier and pay channel, can only be installed in the apartment itself, because of the loop system. Obviously, this is not the most secure situation to have. Positive traps could be used on the pay channels, but not for more than one or two because their size will soon become objectionable behind the set. The operator does not won the D-3 net so he cannot change the configuration to homerun and the owners will be reluctant to do so since they just rewired a few years ago. Since he must provide the three must carry channels to every unit the operator must find a way to secure his services without spending huge amounts of capital. One of the solutions to this dilemma is to use a modified addressable box which will receive data at a lower frequency. Another possible approach might be to use a combination of a block converter, for the expanded basic tier, and a positive trap for the pay channel. This last solution would certainly be viable and may represent the most economical approach but what happens when additional programming becomes available or the operator wants to try PPV? Again, the addressable converter seems to be the best bet. The issue of PPV also runs into complications. A two-way converter could be used, but the subscriber outlet again causes problems. This piece does not use F connectors, instead the connections, internally, are made with screw contacts on the center conductor and shield.

These devices have higher losses and are more prone to ingress/egress than similar parts in America. This means that the return data may not have the strength to get back to the system at a reasonable level or in a non-corrupted state. Faced with this, the operator still has a couple of options available. He can rely on a phone-in type approach to PPV event ordering or use a phone return type of two-way converter. He might even consider a converter which can be downloaded with pre-paid credits which are used up as events are watched. The problems, while numerous, are not such that with a little ingenuity and thought cannot be overcome.

CONSTRUCTION METHODS

Most, if not all, of current CATV construction in Europe is underground. Actual construction methods are very similar, as they must be, to those used in America. The use of concrete saws, trenchers and rock saws is common. In some instances, because of the uncertainty about other utility locations or extreme congestion, hand digging is employed to minimize damage to other facilities.

Construction in the streets is rare. Most of the underground in the U.K. for instance is placed underneath the sidewalks in front of the dwellings. Density and traffic play a large role in the complexity of construction in urban areas like London. A good deal of time is spent in clearing parked vehicles, controlling pedestrian and traffic flow and maintaining a safe construction site. Local regulations can add to the complications. Some municipalities require that all the spoil removed from trenches be hauled off site. Trenches are then filled with a slurry mix and the sidewalks refinished. Restoration of the sidewalks can be quite complicated as well. Asphalt sidewalks merely need a hot asphalt fill, sometimes following a cold patch. Sidewalks which are made up of flagstones need to have a layer of sand put down and the paving blocks reset (or replaced if they have been damaged). Some sidewalks are made of concrete topped with a mastic coating. In these cases the concrete must be poured and, when cured, the mastic must be redone. This requires hand finishing of the hot mastic substance and is not only time consuming but expensive as well.

The age and density of the areas leads to a good deal of congestion in the underground plant. The lack of accurate records indicating utility locations, as noted earlier, can lead to incredibly complex coordination problems. Damage to existing underground structure is not uncommon and must be considered as part of the cost of construction.

The capital required to build plant is higher because of all of these factors. In relatively clean areas, costs should be in the neighborhood of $70,000 to $80,000 per mile. Areas with extremely high density or unusually difficult construction can experience even higher costs. Because of the density, even very high per mile costs can translate into pretty reasonable costs on a per passing basis.

LABOR AND TRAINING

Because CATV is relatively new in most areas of Europe there is not a pool of experienced people to draw from to build, maintain or operate a system. There are a few people who have worked with earth stations, SMATV systems and who have done MDU wiring but often they are unfamiliar with the stricter requirements of cable. European operators are basically starting from scratch in building up a work force. This includes all of the various job functions from installer to CSR to salesman to manager.

The operator faces a decision regarding the makeup of workers. Should he import experienced people or try and train local workers? The exclusive use of expatriots is often resented and can serve to the operator's disadvantage. On the other hand, trying to make a system successful with inexperienced people can also lead to severe problems.

A system operator can use one of several courses to resolve this dilemma. The most obvious is to import a small number of experienced cable people and utilize their experience to train a local work force. This has the benefits of keeping overall costs down (it is very expensive to move people in Europe and keep them there) and building up a good community identity. Once local workers have been trained and have gained some practical experience they will be in high demand because of the scarcity of such personnel. Fair labor practices and good wagfes become a must to retain qualified people and avoid the costs of constant retraining. One other training method can be considered. This involves sending a small group of local people to the United States, or another country with a lot of cable systems, and having them train there. These people can then return and train others with the knowledge they have acquired. Either method practical and the approach used by an operator will depend on his resources and the timing involved for his situation.

OPERATIONAL CONSIDERATIONS

Doing business in Europe can be extremely complicated. There are numerous currencies to deal with, fluctuating rates of exchange and high taxes to deal with. Importing hardware from outside of any country is a complicated process with many potential pitfalls along the way. Operators must think in terms of twenty or forty foot containers of material and planning is necessary several months in advance to insure that needed equipment is received on schedule. Cost planning must take into account the import duties for each nation. Depending on the type of equipment being imported, and classifications vary from country to country even for the same gear, import duty can range anywhere from 15 to 150% of the value of the equipment. Naturally, the rates of exchange also affect this process. If possible an operator should attempt to lock in a rate of exçhange for some period, such as a year or 18 months.

The operator is also faced with starting up or somehow modifying existing billing systems for use in European systems. The whole area of computerized billing service, and addressability as well require a detailed analysis of local requirements. For instance, some people prefer to pay bills monthly by coupon at their bank (this is common in the U.K.). In other countries, quarterly or even annual billing is common. The operator must develop his own billing system, either by adapting existing software or writing the software himself (or having this done for him). It may be possible to contract with domestic U.S. companies who specialize in this area of business to rework their software and equipment to conform to European needs.

Future Trends

The future of CATV in Europe can be viewed from a number of standpoints. There appears to be a need for additional services in most areas but penetration levels, at least in some newer systems, are somewhat disappointing. This relates to the cultural differences in how TV itself is used and the subscriber's perception of the new services. The high density of many areas is a compelling reason to investigate European CATV but this must be balanced by realistic expectations in penetration and a full realization of high construction costs involved.

Europe as a whole is much more interested in DBS than i8s the U.S. Several DBS satellites have been planned and at least one has been launched. DBS could pose a real threat to the development of CATV as could MMDS, potentially. The opinion of European operators is that the greater diversity and lower cost of cable will eventually prove t5o be the deciding factors.

Newer technology, are also beginning to make themselves felt in Europe. France has done a tremendous amount of research and development in the area of fiber optics plant. The end results of their experiences could affect future cable system configurations in a major way. Likwise, the development of HDTV is of concern to operators. They will be faced with the same questions which now confront American CATV systems. What bandwidths will be needed to accomodate HDTV channels? How much will system technical criteria need to change ? Will shorter cascades be necessary? How will converters be adapted to handle the new signals? At the same time, HDTV could present additional revenue opportunities so the questions are all valid and require well thought out analysis very soon.

To summarize, the European CATV scene is beginning to show signs of tremendous potential. However, optimism must be coupled with caution because of the risks involved. Europe is on the verge of explosive growth in CATV but competing technologies also have a window of opportunity which could negatively affect this potential. All in all, watching our European counterparts develop their systems should prove to be most interesting over the next several years.