

Digital Television Receivers
in Canada:
(set-top boxes)
Their Industrial and Policy Implications

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Why is the digital receiver important?

Broadcasting in Canada will change fundamentally with the penetration of digital television receivers – also known as set-top boxes – into Canadian homes. This paper will outline the projected reaction of the different segments of the industry to the new relationships made possible by this technology, and the implications for public policy and regulation.

Most of these implications are captured by the concept of "gatekeeping" – the ability to control access to the consumer. This is already a familiar concept in broadcasting, but the digital receiver universe will enable forms of gatekeeping that are both more complex and more thorough.

In contrast to the gatekeeping model is the open marketplace, in which there is open access by all providers to all consumers. The digital technologies under discussion are quite capable of sustaining the open market model too. Whether the system's future is dominated by one model or the other will depend in large part on deliberate decisions that are taken over the next year. As the key decision-making points approach, it is necessary to understand these technologies and their potential uses.

The analog to digital transition

There are many shortcomings to the analog standard world. Engineers complain that the National Television Standards Committee specification which governs our transmission system – or NTSC – actually stands for "Never Twice the Same Colour". And they have a point: to make a quantum leap forward new digital technologies are needed.

But NTSC has the huge advantage that it is a standard. Every house has a receiver – and all receivers function in the same way. Features vary: some sets are colour, some have stereo sound, some display closed captioning – but the program provider can feed them all with a single signal in confidence that they can all use it. The consumer can also be confident that a set bought in any store will work with any signal. Consequently the consumer provides the reception equipment; it is not a capital cost for the service provider.

Using analog standards, cable television was able to create communication networks, including analog set-top boxes (that is, channel converters) and expand the number of services that a home could receive. But this development also introduced the possibility of gatekeeping. The new services could only get to the consumer through cable. The connection provider could choose whether or not a signal was carried, and what the terms of carriage were to be.

This ability then created a regulatory regime in which gatekeeping was used to further public policy – keeping the system predominantly Canadian – but was controlled by a number of rules about access to systems for Canadian and foreign services, prevention of self-dealing, and so on.

The development of the Internet, however, suggested that another model was possible. The Internet is also a communication network, but one in which openness is the rule. In general ISPs do not act as gatekeepers over content – they provide a simple connection between content providers and consumers.

As Internet speeds increase, analysts have projected that this model might extend itself into broadcasting, with digital content coming through wide open pipes to the TV set. Broadcasters could bypass connection providers. Equally, primary content producers could bypass broadcasters, and go directly to the consumer.

However, if the set-top box becomes the dominant receiver for this digital content – certainly one possibility – then a different model could develop, in which the connection provider once more acts as gatekeeper, but in a more subtle, and potentially more thorough way.

Standards in the world of digital data

The digital data world for broadcasters is strongly influenced by the personal computer industry, which is based on a completely different model for technical development: the headlong rush to be first to market. In this model, no one waits for standards to be agreed. The resulting innovation has substantially transformed our economy in only a few years.

However, the consumer faces much more risk in this world. The consumer has no assurance that one piece of software will work with another, or that it will not be obsolete within a few months. By contrast, a TV set, governed by standards, can typically be used for a decade or more.

This new model of technical development has now found its way into the television world with the arrival of the digital receiver in the form of the set-top box. While over-the-air digital receivers are standardized, set-tops vary in many important ways. In terms of interactive data, the new digital receivers may

- not be universally available for many years
- not be the same from system to system
- not be the same from house to house, and will even
- change from moment to moment

Why? The digital television world is not without standards, or at least the attempt to develop them, but they are not sufficiently advanced or thorough enough in North America to ensure that consumer equipment can be truly interoperable. The ATSC standard, which Canada has adopted, is for over-the-air transmission only, and the part of it which deals with data is not yet completed. And set-tops are the technology which is rolling out now - ATSC receivers in any quantity in Canada may be years away. In the set-top world, even audio and video, governed by MPEG2, are not sufficiently standard to ensure that, for example, an ExpressVu receiver will work with a Star Choice signal.

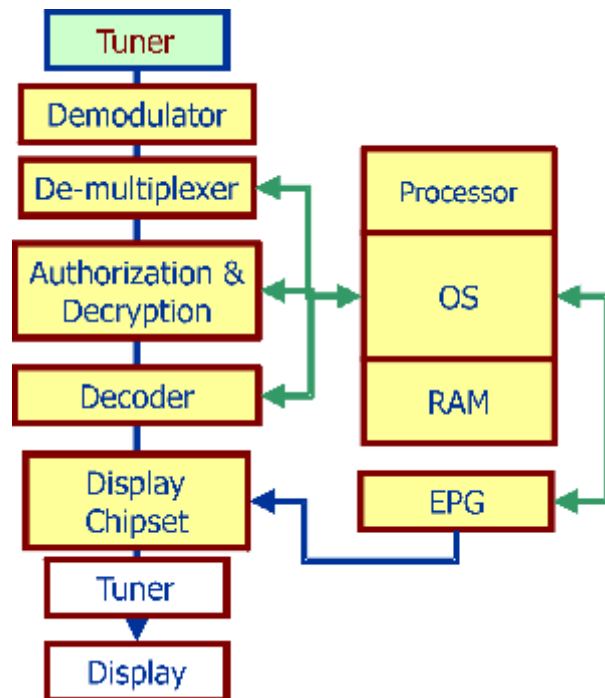
Several years ago, the Canadian TV industry tried, within ABSOC, to choose a digital TV standard for Canada. Industry Canada officials asserted in meetings that a standard would be promulgated. But it didn't happen, and the result is a digital marketplace segmented by the technology choices of the BDUs.

Technical market segmentation will become even more complex as interactive television applications develop. And of course, the greater the technical divisions between BDUs, the greater the potential for gatekeeping activity, since both providers and consumers will be captured by the BDU's technical choices.

The Technologies

Before going further, the technologies themselves should be examined in order to understand their implications.

There are certain basic functions that any digital receiver must perform. To begin with, it has to tune the service the viewer selects. Since television services are multiplexed together in groups for digital transmission, that means that the box must first tune to the combined signal, then demodulate it to extract the digital bits from the satellite, cable or wireless cable signal. Once it has the combined bitstream, it must separate the digital packets that belong to the service the viewer wants. If the service has been encrypted it must check that the user has authorization to view that service and then decrypt it. And finally it must decode the compressed digital bits so they can be converted into analog pictures and sound for the TV set.



Significant Differences

Even at this level there are significant differences between technologies, based on the nature of the BDU's network. Cable, wireless cable, over-the-air and satellite use a variety of different modulation schemes and frequency bands to get the best signal through their particular transmission environments. This in itself is not a barrier to standardization, since one box can contain hardware to cope with these different environments, and retail manufacturers like Thomson and Sony will certainly expect to build receivers that can handle all of them.

The DSL set-tops uses by telephone companies to receive TV over standard telephone wires are quite different. Since the telephone wire has limited digital capacity, the tuning is done in the network, not in the box, so that the network sends only one channel at a time to the home. The new VDSL receivers can send three TV signals at a time, or one high-definition signal. In some ways, this is an advantage. Since the network is tuning channels directly from a fibre-optic feed, there is no practical limit to the number of services a DSL network can offer to its subscribers, while over-the-air, cable, and satellite will all have practical capacity limits.

This is one way in which not all of the receiver's functions have to reside in the set-top. Some "intelligence" may reside in the BDU's network, before the box is called in. Some functions may reside in other media appliances in the home, attached to the set-top box. Or, all of the functions may reside in the set-top itself. For that reason, it makes sense to think of the receiver as a collection of technologies, rather than a single appliance.

Levels of Receiver Power

Even to perform the functions of a minimal digital set-top, the box must have a processor, memory, and an operating system, just like a computer. And that means that it can run applications, just like a computer. The complexity of the applications will be limited by the amount of memory it contains, the speed of the processor, and the efficiency of the operating system, but even at a minimum, every set-top is capable of providing an electronic program guide. In fact it's a necessary feature if the viewer is to navigate the large number of services now available.

As the power of the box increases, more complex applications become possible. Simultaneously, there begin to be variations in the receiver not only from system to system, but from house to house, since consumers and providers may choose boxes of different power, and different applications within that box.

By my count there are something like 15 different models of digital set-tops either deployed in Canada or planned for deployment this year. Since that's too many to deal with, I've constructed a rough grouping of these into four levels.

Level 1 boxes perform the basic functions described above and are also usually capable of supporting video on demand if the BDU network is capable of providing it. The box must therefore have a modem of some kind: either a telephone-line modem, or a cable response system capable of sending an order for a movie back through the operator's network.

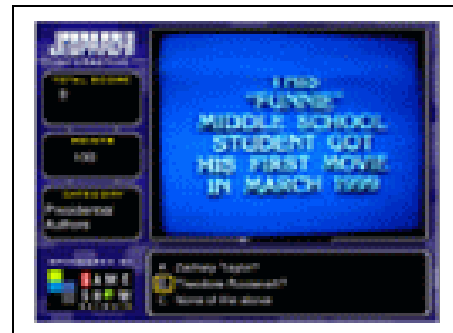
Level 2 boxes can go beyond this into limited forms of interactivity. They need more memory in order to support functions like email, chat, and sometimes "closed" or "proprietary" interactivity. That is, a level 2 receiver is powerful enough to run software that will allow the user to browse through a walled garden of content, though not with all the plug-ins and other features that current computer browsers support. They can, however,

support interactive services, using on-screen response buttons and a remote control to interact with commercials that qualify buyers or enable ecommerce transactions.

Often, however, these proprietary forms of interactivity require the BDU to install special hardware and software within their network. Consequently, while plans are not final yet, there hasn't been evidence of enthusiasm for this kind of interactivity among Canadian BDUs. So while many of the boxes in the marketplace right now are at this level, they may only be enabled by the operator to support level 1 functions.

ATVEF interactivity

Level 3 boxes have the power to run "open" interactive applications. In this context, "open" does not refer to an officially promulgated standard as yet, but to the specification produced by the Advanced Television Enhancement Forum, or ATVEF. The ATVEF specification describes how to encode interactive data in both analog and digital signals, using Internet-based standards such as IP and web pages described in HTML. ATVEF allows the interactive data to split the screen with moving video, and is the format used by most North American interactive TV shows including "Drop the Beat" on CBC, "Jeopardy" and "Wheel of Fortune", "NBC Nightly News" and so on.



Source: Columbia TriStar

Canadian companies like Extend Media and Blue Zone are working with both independent producers and Canadian and US broadcasters to add interactivity to their broadcasts. The specialty applications that were filed at the beginning of this month may reveal more plans to use ATVEF interactivity.

Hopefully they will also reveal what plans the BDUs have developed to support interactivity at this level. The only boxes currently in the marketplace that may be used to support ATVEF are the Scientific Atlanta Explorer 2000 and the PACE/Acorn units used by Vibe Vision, but their providers have not indicated whether they will enable them with an ATVEF interpreter.

Beyond that, however, each BDU has plans to distribute an Advanced Set-Top that is more than capable of handling this level of interactivity. The best known are the Motorola DCT 5000, the SA Explorer 6000 (both cable units which include a DOCSIS standard cable modem) and the Echostar Dishplayer 500, which is compatible with Bell ExpressVu's system. The Dishplayer 500 is already deployed in the US, and contains a full ATVEF interpreter in the form of Web-TV Plus, as well as a hard disk video recorder.

ATVEF is not the end of the story. There is still a need for a true standard, one that is universally recognized, not simply by the consortium of companies that make up ATVEF. While standards processes are always accompanied by controversy, the work of the Advanced Television Standards Committee - whose standard Canada has officially adopted

for over-the-air transmission – Cable Labs, and the SCTE may soon result in an official and universal standard for the delivery of interactive applications. And hopefully, the boxes being deployed this year will be capable of supporting that standard when it comes. Otherwise, a very large part of our market may have receivers that are in one way or another proprietary.

Home Gateways

Some of the boxes available this year are at level 4 - the home gateway. In fact, one of these, the Next Level box used by Bell in its trial last year, is actually called a residential gateway. Level 4 boxes add an element of connectivity that enables them to feed other units in the house. Computers may be able to hook up to the Ethernet port on the back of these receivers to connect to the Internet through their cable modem, and as the basis of a home network. Other audio and video units may connect digitally through the Firewire port. They may have a printer port for coupons, and so on. In short, the set-top box at level 4 may be a contender to be the gateway for all data into the home.

Within these levels, however, there are optional technologies that may be "outside the box", that is, they can exist as standalone devices. The most important are the high-speed, or "broadband", modem, and the digital personal video recorder, or PVR. The PVR is already built in to the Echostar Dishplayer, (to be used by ExpressVu) and it will be an option on all the advanced set-tops. It will also be present in some homes as a stand alone device, in either analog or digital forms. However it comes, it will create a profound change in the way people use television.

As most TV industry watchers know already, the digital hard disk recorder uses an electronic program guide to permit the viewer to select programs for recording. Since it can record and play back at the same time, it can also be used while watching live television, to permit the viewer to "pause" the show or replay parts of it. The show is still recording in the background, so the viewer can resume where they left off, catching up to real time by fast forwarding or skipping commercials. And, since the PVR is software controlled, it can also record the viewer's habits or preferences to enable it to record programs – on its own initiative – that match the viewer's taste, using tools like the "thumbs-up and "thumbs-down" buttons on the TiVo player.



Needless to say, the information collected about viewer habits and preferences has great value in an interactive world. It proves the value of commercials, it enables the data owner to send targeted commercial advertising to each user's hard disk, it may even influence the way in which programs are made.

EPGS

Users of these devices already report a strong tendency to forget about "live TV" and use the material the box records as their prime time viewing. And beyond that, the PVR software offers "Showcases" which promoted partners of the PVR distributor. All of these capabilities are software controlled, so that the viewers' choices can be influenced by the data in the controlling electronic program guide. Clearly, there is advantage in partnering with the provider of the EPG.

The New TV Economic Model

Even as a standalone device, the PVR will alter current economic models for television:

- It devalues commercials;
- It devalues the "niche" programming strategy, since the unit can record specialized programming anywhere, not just on a specialty channel;
- It devalues prime time and prime channel placement and instead puts the creation of good TV "shelf space" in the hands of the electronic program guide or the special promotional arrangements that the provider makes with services; and
- It can collect commercially important information about viewers and their preferences.

When the PVR is combined in a digital receiver platform with the high-speed modem and Internet software, the consequences are even more profound:

- The user can now download entertainment quality content from – potentially – any source on the Internet. 200 channels grows to become an infinite number of program sources.
- The user data collected may include ecommerce data: purchasing habits and site visits.

At the same time, the new digital receiver platform creates opportunities to match the challenge. Interactive content and commercials can permit the development of TV-commerce. While traditional linear commercials may be devalued, interactive commercials can qualify customers for the advertiser, prove that viewers are paying attention, and even lead directly to sales. While the viewer may have a thousand choices, of programming, that programming can be made more attractive and even "sticky" so that viewers tune away less. The PVR can be used to record alternate versions of commercials in advance, so that the viewer sees ads that are relevant and interesting, according to their profile.

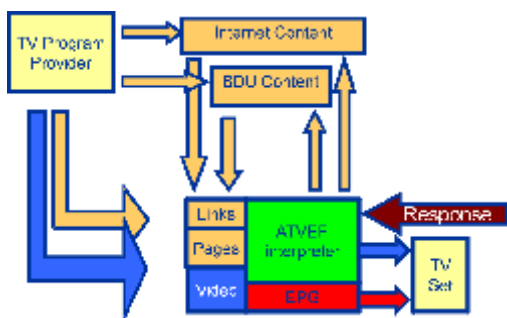
So the new digital receiver platform will change and threaten the economic model for television – but it can be used for a new model, creating new revenue streams that may be even more important. For the program provider, however, this opportunity depends on access to the interactive features of the consumer's receiver.

It's important to note that we're not talking about features that are on the margins of the TV economy. The current projections provided by cable and DTH are, in my view, somewhat conservative in terms of the penetration of set-tops, but they project close to 5 million subscribers in 5 years. They don't, unfortunately, tell us anything about what features will be available on these set-tops. U.S. projections, however, put television interactivity in the hands of 20 to 30 per cent of all households within five years, and PVRs in about 20%. And of course these are the most interesting households from a commercial viewpoint, as the sudden enthusiasm from major advertisers and indeed, the whole industry, shows.

Hence the concern about the gatekeeper model.

Alternative Futures

Perhaps the simplest way to discuss these issues is to look at two alternative futures, in which the Canadian broadcasting system evolves either according to a gatekeeper model or an open market model.



In both of these models, the service provider continues to transmit a program stream, which is carried to consumers by BDUs. The program stream contains video, audio, and now data, formatted to a standard – for now probably the ATVEF specification.

In an open market model, this data would flow freely to the consumer receiver. Since it is in standard format, the consumer can choose any of a number of ATVEF interpreters to receive it. In fact, the consumer may have bought this receiver at retail, from Sony or Thomson etc., and may have installed software from a website or the unit's DVD drive.

The data sent with the TV program and its advertising may be complex, allowing the viewer to play along with a game show, for example, or it may be as simple as a button to buy a pizza. When consumers interact with the data sent by the program provider, they can access sites on the open Internet, seeking information, making purchases, etc. through pages provided by the program provider and its advertisers. And, of course, they can also interact with content provided by the BDU on its own services.

The box and its software are capable of storing data about the consumer's habits, but since they may have bought their own software they have, potentially, more control over how and when it provides data about them to others.

And again, since their own software may be from the open market, they may have a choice of what navigator software they will use to operate their television, their hard disk recorder,

and so on. It may be an EPG provided by their BDU, or one provided by a television station, or even one downloaded from an Internet provider.

Clearly, in this model, the consumer has a lot of choice, and many competitors have open access to the consumer to sell services. But it would be naive to suggest that there are no downsides to this model.

First of all, since the BDU does not control or approve the software on the set-top, it is possible that not all programs will work well together. Supporting the programs will not be the BDU's responsibility, so the consumer will have to make their own arrangements for support.

A cautious consumer would only use software that is certified to work within the standard, which means some delay in getting software to market. There would be similar delays in having software certified by the BDU, so this model will probably do more to encourage software innovation than the gatekeeper model.

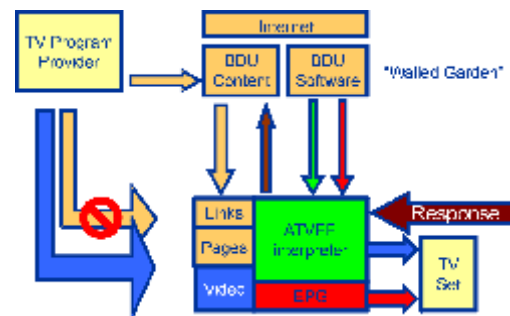
Second, paying the BDU is an issue in this model. Clearly, the connection provider has to invest in network infrastructure to make all of this work. They can charge for the connection, and for the modem services as they do now, and they can provide their own services to their customers, but they will not have strong bargaining power to take a share of the revenue that is generated by interactivity. Some kind of agreement on revenue sharing may be needed to keep the BDU interested in providing the network infrastructure. Such an agreement could be structured by telecom rules, or it could be a matter for general industry agreement that satisfies the regulator that the market is working on its own.

The Gatekeeper Model

The gatekeeper model starts in the same place, but introduces several points at which the BDU may intervene in the relationship between the service provider and the customer.

First of all, the BDU may simply strip data out of the service's signal and refuse to carry it on the grounds that they are not obliged to. They carry the video and audio to the consumer, but no data – unless the service agrees to their conditions for carriage.

These conditions may include special technical arrangements, in which data is carried by another route to the consumer, one that is provided by the BDU, rather than simply in the program provider's MPEG2 bitstream.



In the gatekeeper model, all of the software in the set-top is provided by the BDU, downloaded to the consumer through their network. This is another point of intervention

which gives the BDU control over the interaction. While Canadian companies have expressed a preference for standard software, there is no firm commitment, and there are signs that they will choose solutions that require their technical intervention between the provider and the consumer.

One example of this may well be that there would only be a single electronic program guide available to the consumer – provided by the BDU.

In some cases – cable, for example – the return path for interactivity comes back through the provider's network. Under these circumstances it is possible to create a preference for content that is within the BDU's "walled garden", and discourage the user from accessing the open Internet.

And of course, data collected by the box about the customer's habits would be under the control of the BDU. Given good policies and legislation, this may not create a privacy concern, but it is an important component in the commercial equation, since the program provider must have this information in order to maintain the value of their advertising inventory.

In short, various techniques can be used to create a closed system, in which the program provider cannot address the consumer's set-top directly. Rather, the system is constructed so that the BDU's network is essential to interactivity. Consequently the program provider must serve the network, rather than the consumer, and the BDU controls the interaction with the consumer.

There are advantages and disadvantages to this model as well. Clearly, the BDU has the incentive to provide the network infrastructure and invest in the receivers. Since retail set-tops will not be available for some months, this may be important.

Secondly, the network is under one control and will arguably work better. The BDU will have the responsibility for providing all the software, ensuring it works, and maintaining it.

On the minus side, providing and maintaining both hardware and software creates a large capital and operating cost for the BDU. They are taking a lot of the risk in this model.

Also, the incentive for the program provider to invest in interactivity is much less, since all the bargaining power is in the BDU's hands. The program provider will see less revenue, so one would expect to see less innovation from program providers.

Thirdly, different BDUs will probably adopt different technical solutions, making it difficult for program providers to serve them all. In the open model, one signal went to everyone; in the gatekeeper model, special technical arrangements will likely be necessary.

Fourthly, the consumer will have less choice in this model – less control over what they can do, and potentially, less control over the use of information about their viewing habits.

Finally, the new gatekeeper model cannot be used, as the old one was, to keep foreign services out of Canada. The set-top box is not the only possible gateway for content into the home. If Canadians find they can get good foreign services on high-speed Internet connections, and move them into standalone PVRs and their TV set, they will do it. If the gatekeeper model is used to try to resist market pressure for openness, there will eventually be a new grey market in television services.

Public Policy and Regulation

At this time, I won't try to predict which of these models will develop in Canada. However, it is certain that if the gatekeeper model is pursued too aggressively, there will be calls for government and the regulator to intervene, and design rules to ensure a level of openness.

Government and the regulator may well prefer not to intervene. At this point, they seem to believe that competition among BDUs will force them to adopt open standards and an open market model. By contrast, the FCC has felt compelled to move, mandating open cable standards that would permit set-tops to be sold at retail. Canada currently has no such rules; Industry Canada apparently believes that the market pressure will be sufficient.

I am less confident that this will occur. In fact, one might suggest that the existence of an open standard technically is a pre-condition for an open market. That is, if a single box works on all systems, and all the consumer must do to change service providers is get a new smart card and possibly an antenna, then there will be open competition among connection providers. If the consumer must purchase a different set-top box, pay installation fees, learn new software and a new EPG, the pressure to stay with one provider will be strong.

I can see government and the regulator being asked to deal with a number of basic issues:

- Rules to compel the use of open and interoperable technology so that set-tops can be sold at retail;
- A decision on standards for interactivity: the extension of the ATSC standard, or ATVEF, or whatever Open Cable and the Society of Cable and Telecommunications Engineers devises; noting that, to be effective, such a standard would govern the behaviour of software inside a digital receiver;
- Rules to protect consumer privacy;
- Rules to manage the relationship between providers and carriers on e-commerce revenue. Will all digital bits be a "must carry"? Will a tariff-based "carrier" role be preferred for BDUs? Or will BDUs have the freedom to act as gatekeepers?

- Rules about EPGs: who can provide them, whether BDUs must carry all available EPGs, whether EPGs can prefer one service over another, whether they must prefer Canadian services over foreign, etc.
- Rules to prevent self-dealing with interactive services within vertically integrated or affiliated businesses.

This kind of regulation will be complex and difficult, and one would not want to rush into it, firstly because it demands a level of technical knowledge that is difficult to acquire and maintain in a changing environment, and also because of the very real risk that onerous regulation will stifle innovation and investment.

At the same time, the risks of inaction should not be ignored. Some level of regulation may be unavoidable. Even to "let the marketplace decide" there must be rules that prevent any one party from controlling the software inside the receiver. And time will tell – quite soon – whether the marketplace is operating to maintain a balance between carriers and providers or whether policy must manage this relationship.

Conclusion.

Data and interactivity will not be at the margins of the television system for very much longer. With the increasing penetration of digital receiver platforms, the old economic model for television will give place to a new one in which revenue from these sources will be increasingly important.

Program service providers must have interactivity to protect their existing businesses. As a consequence, they must be able to access the advanced features of the receiver platform in the home. Connection providers seem themselves increasingly as service providers – they have a strong interest in control over the receiver platform to maximize their own revenue.

It's not hard to see the potential for a divisive argument between the proponents of the open market model and the gatekeeper model. But I don't believe that the industry can fight about this for a long time without sustaining real damage from foreign competition.

The digital receiver platform will put our television industry in competition with US program providers. Canadian licensed and approved services will not be the only ones providing content to the TV receiver through Broadband modems and PVRs. And even the gatekeeper model won't keep them out.

Our industry as a whole has a strong mutual interest in creating innovative interactive services as soon as possible, to develop the Canadian market before others do. In fact, this is important not only to our television industry, but to all Canadian business interested in e-commerce. The TV-commerce infrastructure is needed, and soon.

The fastest solution for the Canadian broadcasting system is the development of industry-wide agreements that will work for all players in the system. If regulation must be used to settle differences, it will take a great deal longer, and may not work as well.

The integrated players have an advantage in that they can create these agreements inside their companies. But the open market must work too. General agreement on interoperable technology is necessary, even if an official "standard" can't be reached, to keep the system simple and efficient. At the same time each player may need to set aside its "rights" and recognize that sharing of risk involves sharing of revenue, so that investments made in interactive services can be recouped without the creation of technical "toll-booths".

Two decision points on these questions are fast approaching. A policy hearing on over-the-air digital television is expected within this year. It will certainly deal with these issues. This summer, the digital specialty service hearing will also need to address them. If any degree of interactivity is proposed, then we will get our first look at the proposed relationships between program providers and BDUs.

There is some reason to believe that the signs will be positive. But make no mistake – if the industry cannot reach a satisfactory agreement that lets all parties profit and respects our policy goals, we will have a regulatory battle over the control of interactivity in the new world of television – a battle that can only make it more difficult for any of us to succeed.

David Keeble, April 15, 2000