Migration of Customer Utility Services to Wideband Communication Media

Report, August 1999

International Energy Agency Demand-Side Management Programme
Task II: Communications Technologies for Demand Side Management Report, 1999:
'Migration of Customer/Utility Services to Wideband Communication Media'

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'Migration of Customer/Utility Services to Wideband Communication Media'
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Summary
Utilities providing enhanced customer service across a widening range of activities and increasing customer focus of the businesses are features of the directions being taken by utilities in many developed countries. A critical issue in the provision of advanced, energy related services, is the choice of communication medium or media having the capacity, reliability, associated costs and technological potential to meet the needs of future data exchanges between suppliers and customers in a cost effective manner. Increased penetration of cable television, together with two way terrestrial and satellite communication using other media for the return channel, mean that there are or will be several potential means for wideband information exchange between customers and suppliers. Consequently there is a dilemma in the choice between narrowband and wideband communication media with wideband media offering greater potential in the future. This study quantifies the potential, capability and cost of wideband media to complement narrowband media in the provision of identified services. The report concludes that scenarios of services being provided by narrowband media with migration, at some time in the future to wideband media is a real possibility, as are narrowband only and wideband only options. The report also concludes that a low cost, flexible narrowband gateway will be required to interface wideband media, external to the home, to narrowband media within the home. The prices quoted by wideband network operators for use of their infrastructure for the provision of customer/utility services are considered to be too high but are negotiable.

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Contents

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Glossary

ADSL	Asymmetric Digital Subscriber Line
AMR	Automated Meter Reading
ATM	Asynchronous Transfer Mode
CATV	Cable Television
CHP	Combined Heat and Power
CLEC	Competitive Local Exchange Carrier
CRTC	Canadian Radio and Telecommunications Commission
DSB	Demand Side Bidding
DLC	Distribution Line Carrier
DTH	Direct to Home
ESG	Energy Services Gateway
FTTC	Fibre to the Curb
HQ	Hydro Quebec
IP	Internet Protocol
LMCS	Local Multipoint Communication System
MMDS	Multipoint Multichannel Communication Systems
MPEG	Motion Picture Experts Group
MSO	Multiple System Operator
OH	Ontario Hydro
POTS	Plain Old Telephony Services
PV	Photovoltaics
SMATV	Small Master Antenna Television
telco	Telecommunications company
UBI	Universal, Bi-directional, Interactive
UMTS	Universal Mobile Telecommunications System

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Migration of Customer/Utility Services to Wideband Communication Media

1 Introduction

Utilities providing enhanced customer service across a widening range of activities and increasing customer focus of the businesses are features of the directions being taken by utilities in many developed countries. These additional services can include remote metering, end use energy consumption information on an itemised basis, planned and unplanned supply interruption details, data services, promotions and Internet access, as well as information on supply quality.

A critical issue is the choice of communication medium or media having the capacity, reliability, associated costs and technological potential to meet the needs of future data exchange scenarios between suppliers and customers in a cost effective manner.

Communications media considered for the most critical link in the chain in terms of cost justification, that immediately connected to customers, are low power radio, mains borne LV network signalling and local telephone exchange lines. Increased penetration of cable television, together with two way terrestrial and satellite communication using other media for the return channel, mean that there are or will be several potential means for wideband information exchange between customers and suppliers. Consequently there is a dilemma in the choice between narrowband and wideband communication media with wideband media offering greater potential in the future.

From the perspective of a utility considering the provision of customer value added services using communications as a means of differentiation in competitive supply markets, which choices of services to offer and which media to use are difficult. The most cost effective services, the customer market penetrations and the technical and financial performance of communication media need to be evaluated to assist with business strategy and investment decision.

Due to the timescales involved in any rollout of services, it is likely that several generations of technologies and media will exist in the market at the same time. A flexible approach which recognises this is essential so as to provide future proofing of utility and customer investments and to encourage a market to develop.

This study quantifies the potential and capability of wideband media to complement narrowband media in the provision of services identified. The question of timescales before bi-directional wideband media are available to the majority of residential customers is also considered. Scenarios of services being provided by narrowband media with migration, at some time in the future to wideband media is a real possibility, as are narrowband only and wideband only options.

2 Customer/Utility Services Requirements

The provision of customer/utility services has been quantified and evaluated in Sub Task 7 and reported in Report "Definition and Specification of Residential Customer Gateway for DSM and Related Services", September 1998. This evaluation determined the services likely to be required now and in the next ten years by utility energy businesses for the purposes of adding value to customers and themselves. The motivation for providing additional services is for improving customer/utility relations and for supplier differentiation in competitive energy supply markets. The list of services and their data requirements is repeated in Table 1 for the purposes of understanding. This evaluation of the use of wideband media capacity considers all the services, both presently required and possibly required in the future, to be necessary. Telecommunications and home shopping are not considered to be utility services and have been excluded from the evaluation. Internet access for energy audit purposes has been included as a possible energy business service. However in reality it is likely that Internet services would be provided by other businesses or organisations rather than an energy utility business.

The communications traffic evaluations and service response time evaluations carried out in Sub Task 7 showed that all services, except Internet access could be provided by narrowband communication media (radio, DLC, telephone). Consequently, from a capacity perspective, wideband media could easily meet all the requirements of the services. It is therefore not necessary to evaluate the capacity requirements of the application of services in this strategic study of wideband media application. The important considerations in this study are the financial drivers for using wideband media, as opposed to narrowband, for the provision of present and future services requirements and the migration of services between the two types of media.

A critical result from the Sub Task 7 evaluation of both "in house" and "out house" communication media and protocols was the requirement for a flexible gateway. This gateway was required to interface different internal and external to the home communication media together and also enable operation of the utility services communication bus within customer premises using different protocols. Future proofing customer purchased equipment operating to specific protocols is also an important driver for a flexible gateway. This requirement for a flexible narrowband gateway will also be necessary if wideband communication media are used outside customer premises in order to link to the narrowband home bus. The provision of both narrowband and wideband communication busses within customer premises is the most probable arrangement for the foreseeable future on the grounds of cost. Consequently, consideration of wideband media, external to customer premises, for the provision of narrowband services has been carried out on the basis of linking the wideband customer access unit (Set Top Box, cable modem) into the flexible gateway and then into the narrowband bus. The flexible gateway specified in Sub Task 7 would be required to have the capability of the Common Bus being linked into wideband media access units via a specifically designed daughter board, Figure 1.

Table 1: Customer/Utility functions - Residential Customers
Summary of data requirements

	FUNCTION	E - Essential/ F - Future/ N - Not included	Penetration %	Broadcast	Frequency	Per	Up bits	Down bits	Response time (secs)
	Tariff Management								
1	Meter Rate Switching (2 rate)	**E**	**20**	**YES**	**2**	**DAY**	**0**	**80**	**30**
2	Meter Rate Switching (multi-rate)	**E**	**20**	**YES**	**6**	**DAY**	**0**	**80**	**30**
3	Price Information	**F**	**20**	**YES**	**1**	**DAY**	**0**	**1,500**	**3,600**
4	Dynamic Pricing	**F**	**20**	**YES**	**1**	**DAY**	**0**	**1,500**	**3,600**
	Load Control								
5	Load Switching	**E**	**4**	**YES**	**6**	**DAY**	**0**	**80**	**30**
6	Interruptible Tariffs	**E**	**4**	**NO**	**1**	**YEAR**	**80**	**2,400**	**3,600**
7	Demand Reduction Availability (DSB)	**F**	**5**	**NO**	**1**	**DAY**	**200**	**200**	**300**
8	Load Shedding	**E**	**4**	**NO**	**3**	**YEAR**	**80**	**80**	**30**
9	Intelligent Controllers	**E**	**4**	**YES**	**1**	**DAY**	**0**	**650**	**3,600**
10	Fuel Switching	**F**	**1**	**YES**	**3**	**YEAR**	**0**	**200**	**300**
11	Load Profiling (statistical)	**E**	**15**	**NO**	**1**	**YEAR**	**12,000**	**80**	**3,600**
12	Load Profiling (daily)	**E**	**1**	**NO**	**1**	**DAY**	**12,000**	**80**	**3,600**
13	Generation (CHP, PV) control	**F**	**2**	**YES**	**1**	**DAY**	**0**	**200**	**300**
	Automated Meter Reading								
14	Electricity Meters	**E**	**20**	**NO**	**12**	**YEAR**	**400**	**80**	**3,600**
15	AMR Default/Fraud Control	**E**	**10**	**NO**	**4**	**YEAR**	**80**	**100**	**300**
16	AMR Revenue Bill Forecasting	**N**							
17	Gas Meters	**E**	**10**	**NO**	**4**	**YEAR**	**400**	**80**	**3,600**

18	Water Meters	**E**	**10**	**NO**	**4**	**YEAR**	**400**	**80**	**3,600**
19	Heat Meters	**E**	**10**	**NO**	**4**	**YEAR**	**400**	**80**	**3,600**
	Customer Service								
20	Automated Payment	**F**	**1**	**NO**	**12**	**YEAR**	**1,000**	**1,000**	**600**
21	Pre-payment (Remote)	**F**	**15**	**NO**	**1**	**DAY**	**240**	**240**	**15**
22	Account Status	**F**	**10**	**NO**	**12**	**YEAR**	**200**	**1,000**	**200**

	FUNCTION	E - Essential/ F - Future/ N - Not included	Penetration %	Broadcast	Frequency	Per	Up bits	Down bits	Response time (secs)
23	Supply Disconnection/ Connection	**E**	**20**	**NO**	**2**	**YEAR**	**100**	**300**	**1,000**
24	Maximum Demand Limit	**E**	**15**	**NO**	**4**	**YEAR**	**80**	**160**	**3,600**
25	Itemised Load Monitoring (utility service)	**F**							
26	Quality of Supply Monitoring	**E**	**1**	**NO**	**12**	**YEAR**	**1,200**	**80**	**900**
27	Messages (short) (Data Supply Services)	**E**	**20**	**NO**	**2**	**DAY**	**160**	**14,400**	**120**
28	Dynamic Maximum Demand Limit	**E**	**5**	**NO**	**1**	**DAY**	**80**	**160**	**3,600**
29	Customer Equipment Monitoring	**F**	**2**	**NO**	**1**	**DAY**	**200**	**100**	**3,600**
	Advanced Services								
30	Energy Audits, e.g. through Internet	**F**	**1**	**NO**	**1**	**YEAR**	**100,000**	**100,000**	**600**
31	Information Services/Supply Restoration (long)	**F**	**1**	**NO**	**1**	**YEAR**	**1,000**	**5,000**	**600**
32	Telecommunications (Speech)/email	**N**							
33	Cable TV	**N**							
34	Home Shopping	**N**							
35	Security/Alarms/ Environment Monitoring	**E**	**3**	**NO**	**12**	**YEAR**	**160**	**80**	**30**
36	Home Energy Management	**E**	**3**	**YES**	**1**	**DAY**	**0**	**650**	**3,600**

3 Wideband Infrastructure Development

3.1 Introduction

Existing information infrastructures vary greatly from country to country, but mostly contain, POTS, FAX, DATA (e.g. Internet, Intranet, Web commercial services; downloading of files containing data including audio / video etc) and TV distribution.

There is a large installed base of customer terminal equipment which is virtually all analogue, except for the personal computer. When considering long term developments it is important to note that most of this installed base will be replaced by consumers within a time span of 10 years.

Another very large installed base are the public access networks originally installed for POTS, consisting of the end office equipment (Exchange) and the copper local loop with a length up to few km. Except for ISDN which has a low penetration, access to the customer is analogue with a 3.4kHz bandwidth over a twisted pair. In some parts of Europe coaxial access networks for CATV have also become a very important existing asset. These are currently also analogue and characterised by a tree and branch structure that allows a large downstream-distribution bandwidth, but no (or only very limited) upstream bandwidth for interactive services. Wireless technologies either terrestrial or from satellite form another type of competing access networks. For applications used “on-the-move” these remain the only solution, but developments to integrate mobile networks more fully into global fixed networks are well advanced with 3rd generation (UMTS) systems. For fixed broadcast applications wireless will remain very competitive with CATV technology with digital compression technology (MPEG) making it possible to cram many more channels into the scarce free space electromagnetic spectrum.

Beyond the local loop, telecommunication networks are practically completely digital. Technological developments such as optical communications have in the recent past dramatically reduced the cost of transporting large amounts of data over large distances by several orders of magnitude. This rapid reduction of the cost of bandwidth will continue for the foreseeable future. It is also worth noting that the cost of storing data in RAM or disk has also dropped in a similar way.

In the last 20 years a different kind of architecture has very rapidly evolved, from simple local area computer networks to a world wide web of interconnected computers: the Internet. From a technical point of view, computer networks in general and the Internet in particular, are quite different from classic telephone networks. For instance the Internet offers a “best effort” without a guaranteed quality of service; it started out from an elite base of users and knows no “universal service”; it does not bother about ITU standards; the intelligence resides at the edge of network; no fixed paths are set up through the network, but instead a connection-less Internet protocol (IP) allows each packet of data to find its way separately through the network, from router to router. This last characteristic makes it difficult to guarantee delays or even the order of the packets received, but does provide a remarkable resilience in the network, which was one of the primary aims of the US government when starting the Internet.
Both a major TV manufacturer, Sony and a major PC supplier, Gateway 2000 have announced the launch of an “Internet TV”.

Another important development is the rapid advance in compression technology for video and voice. The bandwidth and disk space required for transmission and storage of audio-visual information has decreased by orders of magnitude. This has

for the first time made the digital form of information more efficient and economical to handle than its traditional analogue counterpart. The current concept that a movie should be transmitted in real time to the customer may be replaced by one where it may be very rapidly downloaded and stored on a disk for later viewing. At a simpler level, digital voice compression techniques have given birth to Internet telephony, at a reduced but rapidly improving quality, provided on a totally different commercial basis to its analogue counterpart.

These technological developments should be assessed in the light of a growing proportion of the population becoming computer literate (especially younger people).

The development of these networks and technologies permit the expansion of existing trials to country-wide or world-wide applications such as:

- electronic commerce
- distance education
- distance health care
- intelligent transportation systems, ...
- quantify impact of each on sustainable development
- banking
- insurance
- tourism
- publishing
- entertainment

Clear features of current communications markets include the convergence in technologies and the cross-over in supply. Traditional suppliers of broadcast entertainment are now supplying personal communications and telecommunications companies (telcos) are supplying entertainment (video-on-demand). The continuing dramatic improvements in the cost/performance of the underlying technologies continue to push back the frontiers of what is commercially possible. The improvement in the performance of computers is impressive but pales besides the improvement in communications performance. The market has been widened to include other players and been opened up to new players who are not burdened with large investments in installed technology.

Traditional broadcasters and their associates, such as cable companies, are adding yet another dimension with their moves into narrow-casting, interactive services and links to the Internet. Each of these cultural groups - communications, computer and content suppliers - has its traditional view of networks and their users. More importantly each has a different view of the relationship between competition and consensus. They will all be forced to re-examine these relationships, even if only the user will be a service provider, from desk-top communications services (voice mail, call filtering, call forwarding, etc) to content provision via home-pages.

The terminal of the future will vary between an active badge carried on the person and a living wall. It is an open question as to where the ideas around Networked Computers (Ncs) and Intelligent Agents will have their greatest impact: the PC, the TV, the telephone or the games terminal. Embedded computers and wearable computers will increasingly be communicating computers: the clocks that are all synchronised by radio; the pager that your PC-based agenda manager calls when you have an appointment; the mobile telephone that knows where you are - almost exactly!

The need for dependable communication, i.e. networks which have very high reliability and availability will grow tremendously. In the business world as well as in the private sphere people will depend on communication networks for many of their activities. Networks will be an essential and often vital infrastructure without which businesses will come to a halt and private citizens will be hampered in their private lives. A host of new economic activities will grow around networks (e.g. electronic retailing, entertainment, publishing and education) which will crucially depend on these networks.

3.2 Market status of wideband network development in participating countries

3.2.1 Canada

Canada is undergoing considerable changes in all sectors of the utility and communication industries in the second half of the 1990s. Previous monopolies have been broken in the last few years and many more break ups are planned. This section summarises these changes and addresses the question of 'migration to broadband' of narrowband services. This information was obtained from various journals, newspapers, Internet and personal contacts. Some could not be substantiated, so is not guaranteed.

Broadband services envisaged:

- high speed Internet
- electronic commerce
- movies on demand
- education services (including remote learning)
- video telephony and conferencing
- telecommuting
- telemedicine (including home treatment monitoring)
- banking and shopping services

Major broadband issues:

- privacy of information
- fair information practices
- universal access

Technology ownership (Canada)

- TV 98%
- Telephone 99%
- Cable 74%
- Computer 40%
- Also 80% of banking transactions are now electronic

The following sections summarise the situations in different sectors that will have a role in the broadband services business:

ELECTRIC UTILITY

Competition is now becoming a reality in a number of provinces following is a summary of activities:

BC – BC Hydro have agreement through FERC (Federal Energy Regulatory Commission) in US to transmit power to US as long as US companies have same rights - thus an element of competition. No information on what they're doing on advanced metering.

Alberta - fully deregulated, main utilities being Transalta Corp, Alberta Power and EPCOR. The former has been considering automated meter reading (AMR), but is considered too expensive. They are considering sub-contracting certain parts of their metering business.

Saskatchewan - Saskpower still a monopoly and there is no known discussion of deregulation. They have looked at offering additional services (e.g. security) through gateway technology (narrowband only), but population density seen as too low to be profitable. Some AMR is in place for difficult, remote sites.

Manitoba - preparing for likely competition but no legislation yet. A lot of work is being carried out on cost cutting and energy management and education programmes.

Ontario - deregulation and competition will have been implemented by the end of 2000. Ontario Hydro (OH) is to be split into five separate entities by April 1999. A trial of narrowband gateway technology, (Energy Services Gateway) (ESG) in 100 homes was completed in 1998, but there are no plans for roll out in Ontario. The ESG technology has been sold and the new owners believe that the advanced deregulated markets of Australia, NZ and California will be more fruitful territories, until Ontario utilities understand the need for value added services to differentiate themselves from the competition. OH along with other North American utilities will be looking to utilise its dark fibre from its own communication system for other purposes and perhaps be a `carrier's carrier' i.e. routing calls for phone companies. OH has several 100 km of fibre around Toronto to augment its microwave and HV powerline communications for system control. A number of retail utilities (town and city based) e.g. Sudbury, Guelph and Orillia are collaborating with phone companies to build an ATM network and to offer telecom services to local businesses.

Quebec – Hydro Quebec (HQ) has just completed a trial of multi thousand home broadband trial called UBI (Universal, Bi-directional and Interactive). Participants were HQ, Videotron (cableco), National Bank, Canada Post and Hearst Corporation. Approximately 300,000 homes in the Chicoutimi region were involved and various interactive services offered. HQ looked after energy management component in 500 homes and linked advanced thermostats and water heater controllers to the system. Some energy savings were seen. The initial trial was completed in 1998 and has not been renewed. The existing equipment was considered out of date and Videotron was going to pursue new initiatives (see below). Hydro Quebec will also introduce competition into its market in 2000.

New Brunswick (NB) - NB government has published a white paper on competition, so NB Power is doing a major exercise in cost reduction. Load research and profiling exercises underway to help customers. No advanced technology use foreseen, although they see gateway systems as useful in commercial and small industrial.

Nova Scotia Power (NSP) - NSP privatised a few years ago and talked of doing advanced gateway trials but nothing transpired.

PEI and Newfoundland - These states are still monopolies.
Energy utility competition in a number of provinces is approaching quickly with cost cutting and customer service as major priorities. However there is little at present in terms of providing added services for customers apart from some AMR and load profiling. Only Ontario and Quebec have undertaken communication gateway trials, but neither plan rollouts for some time to come. Advanced services are seen as too expensive in the short term and competition in energy supply will really have to be strong in order for these to be offered. However both OH and HQ are closely following advanced communication developments, such as Nortel's advanced power line system.

For now, broadband services are considered the business of telephone and cable companies. However those utilities with fibre networks for internal communication purposes (protection and control) are looking to build more, and then lease new fibre and existing dark fibre. The appetite for fibre capacity is considerable in Canada.

PHONE
There have been three major players, AT&T Canada, Call-Net (which bought Sprint Canada) and the Stentor group of companies e.g. Bell and other provincial phone companies, in the long distance market in Canada. Until recently only the Stentor companies could offer local call service in their own territories, but due to deregulation, Call-Net, AT&T Canada, new companies Metronet and Optel plus several cable companies have indicated they will offer local service to most major centres. The Canadian Radio & Telecommunications Council (CRTC - the regulatory body) has indicated that they want to see many more CLEC's (Competitive Local Exchange Carrier) entering the market.

In mid 1998, Bell Canada, which operates in Ontario and Quebec announced that it will compete nationally and formed a new company, Bell Nexxia. The other provincial phone companies, except in Alberta and BC, will effectively become local agents of Bell Nexxia. The BC and Alberta telco's merged to form BCT.Telus in late 1998 and could now be potential partners for Call-Net or Sprint USA. Then in March 1999, AT&T and Metronet announced they were merging and will thus become a major national player to rival Bell, in total service. Bell Canada then went further and formed an alliance with MCI WorldComm to tackle the larger North American market.

Previous R&D initiatives in broadband:
BCTel - high speed network connecting 3 British Columbia (BC) universities (155Mbps)

Telus (Alberta) - broadband media trial in 3500 homes in Calgary and Edmonton including high speed internet and movies.

SaskTel - first telecom company in North America to deploy a commercial fibre network, also developed technology for networked Nintendo and Internet TV for hospitals. Now offering limited ADSL service to customers.

MTS (Manitoba) - will trial a distance medicine application using asynchronous transfer mode (ATM) broadband technologies - delivery real time video for remote diagnosis. Also looking to trial interactive video conferencing for schools.

Bell Canada (Ontario and Quebec) - broadband multimedia trials in London and Repentigny. These have now been completed and were seen as very expensive. An ADSL trial was undertaken in Ottawa and will be expanded to other cities. Bell also worked with Royal Bank and others on the Mondex smart card system (cashless society). This was also seen as expensive and did not generate a lot of interest from vendors and users. A similar exercise in New York was also recently terminated.

NB Tel (New Brunswick) - this most aggressive 'technical' telco has established a wide network of fibre in the province to offer ATM based broadband services. An alliance has been formed with Nortel for equipment development and installation. The system links homes to fibre using co-axial cable. Their Video Active Network has now been expanded to more than 15,000 homes and will offer cable TV and high speed internet.

Canada's fibre optic transmission system

The Stentor Alliance has two high density routes spanning the country from St Johns to Victoria as well as 60,000 km of fibre connecting cities and towns through regional companies. Most fibre only goes to the control cabinet or the curb, fibre to the curb, (FTTC). Links to the home are coaxial cable (more in the future) or twisted pair. Currently AT&T and Call-Net lease fibre from Stentor, but are now building their own systems. A consortium of Ledcor Industries (Calgary) and Call-Net is building a new fibre backbone between Vancouver and Quebec City at a cost of $125M CDN. AT&T was part of the consortium but pulled out. AT&T has independent SONET rings in eastern and western Canada with a digital wireless network in central Canada.

Bell Nexxia aims to have 12,500 km of fibre capacity at an optical signalling rate of OC192 (10Gbps) in Canada and USA by mid 1999. It will offer phone and other broadband services to 12 cities in Canada and 5 in the USA and use a series of SONET rings to overlay the main fibre network plus Dense Wavelength Division Multiplexing to enhance ATM (Asynchronous Transfer Mode) as the optical transport method. Bell has leased some fibre capacity from the Ledcor group to enhance its current fibre network.

Metronet recently bought fibre from other companies and it will form a national service to link its city based voice, frame relay, ATM and IP services. Linked to AT&T it will have national coverage. Metronet also bought the cable company, Rogers', telecom business during 1998, which gave it considerable bandwidth in Ontario. They are now contracting with Nortel to provide the hardware to ensure high speed (Gbps) transmission over their national network.

Advanced Services

Asymmetric Digital Subscriber Line (ADSL) service using telephone twisted pair is only offered in limited fashion. It is considered expensive with an installation fee required plus at least $60-70 CDN/month to break even. Volume prices could bring it down to $30-40 CDN/month. Downstream data rates are ~6Mbps with upstream at 640kbps. It will likely become more competitive when linked to FTTC (Fibre to the customer) systems, not on existing copper technology. However, with Nortel's 1Mb modem technology that doesn't require a splitter, installation would be easier and overall costs lower.

Bell has now decided to deploy the 1Mb modem in Montreal, Quebec City and Toronto early in 1999.

CABLE

There is little in the way of competition in the cable industry in Canada, with Shaw, Rogers, Cogeco and Groupe Videotron (+ small regional groups) having their own territories in the main urban centres. Each of them is looking to compete with telco's for broadband services and to some extent telephone service. Cable costs between $30-40 CDN per month depending on the level of service.

Current Canadian cable television statistics - 1997

TV Homes	**11,482,000**	
Homes passed by cable	**10,285,576**	
Cable TV subscriptions	**8,286,775**	
Homes passed as a % of all TV homes	**90%**	
Cable TV subscriptions as a % of homes passed		**81%**

Rogers: sold its telecom group and fibre capacity to MetroNet so the latter can compete in the Toronto phone market. Rogers is now offering high speed Internet (<1Mbps) via cable modems at an introductory price of $40 CDN/month - the '@home' service and are considered to be taking a loss on each installation in the hope of high volume. Rogers has recently announced a bundling of all its services for certain customers at discount rates. This is to try to offset threats from the phone companies with xDSL technology.

Shaw is developing its own fibre network (Fiber ONE) and intends to enter the phone market as a CLEC. Also offers an '@home' cable modem service.

Both of these cable modem services have just been introduced so that market penetration forecasts are not available.

Videotron - worked with Hydro Quebec on Universal, Bi-directional, Interactive, (UBI) and also have an extensive fibre network. Will also likely enter local phone market. Videotron has now contracted with Cisco systems to deliver an Internet Protocol based system supplying telephone service, cable TV and high speed Internet access over Videotron's existing cable facilities. This is expected to be in service by the end of 1999. They have also announced plans to install Scientific Atlanta's Explorer 2000 set top box in Montreal homes in 1999.

In June 1997, Shaw launched the first digital cable service in Canada and has deployed more than 70,000 digital cable boxes in the Calgary and Greater Toronto areas. These boxes provide increased signal quality, additional channel capacity, extensive music capability and advanced interactive programming guides. Other Canadian cable companies have announced plans to conduct digital trials throughout 1998.

Set Top Boxes

The development and roll out of set top boxes is a global issue now, but it is worth commenting on the North American scene, of which Canada is playing its part. Hardware development and manufacturing are primarily US based.

General Instrument (GI) (formerly called NextLevel Systems) and Scientific-Atlanta are the two largest suppliers of set top boxes to the cable industry and in 1998 both announced significant deals to supply equipment to leading US and Canadian cable companies. Scientific-Atlanta announced early in 1998 that seven cable companies will be rolling out services based on its digital set-top box design. The seven include three of the largest Canadian cable companies. With the Explorer 2000 set-tops,

cable companies will offer the ability to send and receive email, browse the Internet, and later still, offer video on demand. Less than 1 million devices were ordered for 1998, but with significant increases expected in 1999 and beyond.

General Instrument sealed a $4.5B US deal to provide at least 15 million next-generation cable set-top boxes to Tele-Communications Incorporated (TCI) and eight other cable operators. Digital set-top boxes from GI likely won't be ready until mid 1999.

Scientific-Atlanta says its set-top boxes will be compatible with the Open Cable design for interoperable set-top computers that `CableLabs', a cable industry consortium, is proposing. The Explorer 2000 uses a low-cost MicroSparc II processor from Sun and an operating system from PowerTV (see specification below). The boxes that Telewest Communications Inc (TCI) has ordered from General instrument will use Microsoft's Windows CE operating system, and some will incorporate Sun's PersonalJava software for running Java programs.

The Canadian cable industry is participating with CableLabs to establish the Open Cable project aimed at obtaining an advanced set-top box that will be non-proprietary and inter-operable between vendors. CableLabs is a research and development consortium of cable television system operators representing more than 85% of the cable subscribers in the United States, 75% of the subscribers in Canada, and 12% of cable subscribers in Mexico. These new boxes will use the full capabilities enabled by digital technology to deliver a range of new services in programming and Internet browsing.

CableLabs developed detailed technical specifications for Open in 1998 and certified the first DOCSIS (Data Over Cable Service Interface Specifications) cable modems early in 1999. A number of cable companies including Media One in the US, have now stated that they will only buy open architecture, standardised set top boxes. This should force comformity and ensure manufacturers move to DOCSIS standards. Thomson SA, who will market set top boxes under the RCA name, and Motorola, are strong proponents of the open architecture and see this as a good marketing tool against other proprietary protocols.

Prices of set top boxes are likely in the $300-500 US range with the desire to get the price below $300 US by 2000. Toshiba and Thomson recently announced that their cable modems, which are CableLabs certified, will be in computer stores shortly for retail purchase. Current lease charges of modems from cableco's are around $10 US per month.

Specification of Scientific Atlanta's Explorer 2000 product

- Instantaneous, two-way communications based on Internet Protocol
- The most powerful high-speed RISC processor (Sun MicroSPARC II) presently available in the cable set-top industry
- Based on OpenCable™ specifications (ensures system meets industry standards)
- Ethernet 10BaseT and universal serial bus (USB) interface (supports hook up to the PC, printers and other peripherals)
- PowerTV® Operating System
- Multiple middleware choices including PersonalJava™, HTML, and JavaScript (for application development)
- PowerKEY™ Security System (for E-commerce)
- Smartcard slot (for added security and electronic commerce transactions)

- Eagle™ multimedia technology (for high resolution, photo-realistic graphics)
- Dolby AC3 digital audio
- MPEG 2 compliant

Note the tendency in North America to the USB interface and not RS 232.

WIRELESS – TERRESTRIAL

There a new innovations in the wireless universe that will allow new broadband services to be offered. In Canada, this will help fill in some of the areas not covered by cable, but also these services will be competitive enough to also compete in urban areas.

Local Multipoint Communication system (LMCS): In 1996, in order to foster more competition for consumers, the federal government awarded three franchises for LMCS service in the 28GHz range with a 0.5GHz bandwidth. These cover 66 major markets and 127 rural markets. The companies WIC Connexsus, MaxLink and Rural Vision. The two former companies have now placed nearly $1B worth of equipment orders with Newbridge and Alcatel. They will begin building the networks in early 1999. They will aim initially at the **business market** to offer video conferencing, high speed internet as well as data services. Cost of set top boxes are targeted at US$150.

Multipoint Multichannel Communication Systems (MMDS): Similar to LMCS, but transmitting in the 3-4Ghz range, but considered to be the main competition to cable. MMDS is referred to as wireless cable and is primarily aimed at the **residential market**. One company, LookTV, now offering service in southern Ontario. Only one-way communication, but if this is eventually offered as two way interactive, it could really take off. Service is also offered in Manitoba and Saskatchewan.

WIRELESS - SATELLITE

There are a couple of Canada services now offering Direct to Home (DTH) TV i.e. ExpressVu, and StarChoice. These typically use Telesat Canada's Anik 2 satellite. A new Nimiq satellite is to be launched for widespread service.

Also, TMI communications a division of Bell Canada Enterprises launched the MSAT-1 satellite in 1996 to provide mobile satellite based phone service, primarily to cover remote regions of North America.

There are more continental and global services, accessed by Canadians, and these are summarised in Table 2.

Table 2: Global (main contenders)

Name	Type	Service	Altitude	Owners	Satellites	Service launch
Iridium	LEO	Voice	780km	Motorola	66	Nov 1998
Globalstar	LEO	Voice	1414km	Loral, Qualcomm	48	Q3, 1999
ICO	MEO	Voice	10,390km	ICO Global Comm, Deutsche Telecom, Hughes, Telstra	12	mid 2000
Teledesic	LEO	Broadband	?	Craig McCaw, Prince Alwaleed, Microsoft, Boeing, Motorola	288	2003
Skybridge	LEO	Broadband	1457km	Alcatel, Loral, Toshiba, Sharp, Spar Aerospace	80	20001

LEO = low earth orbit
MEO = medium earth orbit

ANALYSIS OF THE MARKET

Telco's & Cableco's

At the 1998 Canadian Business Telecommunications Alliance conference, several telco industry leaders were asked what services and how many competitors they thought would be available in each region and they summised:

Services	No of competitors
Long distance phone	3 or 4
Local phone	3 or 4
Cell phone	4
Internet service provider	4
LMCS	1
MMDS	1
DTH	3
Cable	1

There is already consolidation in the telco arena, with the big three possibly buying out the competition and each providing long distance, local and cell phone services. Cable companies territories will likely remain as they are, but they will compete with telco's and wireless services for broadband services.

For long distance phone services, Stentor group members are required to allow access to competitors who lease fibre. However, the major ones CallNet (Sprint) and AT&T are building their own infrastructures.

When local service is deregulated in 2000, Stentor companies will be required to lease lines to competitors for up to 5 years. Again, groups such as Metronet are building their own infrastructure in major centres and now, between centres.

Cable companies have no third party access issues.

Utilities

Most Canadian utilities now see competition as a coming reality, they are cutting costs and working with customers on energy management and education. They

have assessed new metering technologies, but see them as too expensive at present. Larger utilities have demonstrated new gateway technologies, but product roll out is some years away. Utilities need to be in a competitive market for a couple of years, before they consider differentiation of services and new value added products. However, as telco's and others are forging ahead with new services, utilities could be left behind. They will offer narrowband services but will need to link with broadband providers in some sort of alliance if they want to remain in the customer service business

Power lines in a competitive Ontario will be owned by a regulated company for HV transmission and by municipal utilities at the distribution level. Any company will be able to offer energy management services to customers, although the existing hydro companies will predominate at least initially. Nortel's Digital Power Line communication technology is being closely followed to assess its capability for utilities to offer value added, broadband services on their own wires

Joint opportunities?
Discussions with two cable companies on the subject of linking a narrowband gateway for utility energy management applications, with a wideband, set-top box, were held. Both thought that this was feasible and that connection could be achieved through the modem's USB port (not RS232). Given that the narrowband communication needs are small, e.g. bursty, transmission at no greater than 10kbps mainly in off peak hours, then the cost should be small, in the cents per home per month. But this would not be worth it for the cable companies and a figure of $ 4-5 CDN/month/house was mentioned. This was very much a guess and this subject will be brought up at the CRTC (Canadian Radio and Telecommunications Commission) in 1999. Currently the average monthly cable bill for TV is $30-40 CDN. Cable modems will initially be approximately $500 CDN to purchase (and dropping quickly) for Internet provision, with the service being provided at least $40 CDN per month. If utilities can justify a few hundred dollars for a narrowband residential gateway, then the cable companies might be very interested in exploring joint service offerings to householders.

3.2.2 Finland

Area:	337,000 sq km
GDP:	US $127 billion
Population:	5.1 million
Total households:	2.1 million
Total TV households:	2.3 million
No. of cable operators :	102
Homes passed by cable:	1.3 million
Homes subscribed to cable:	920,000
Homes subscribing to DTH/SMATV:	115,000
Phone lines installed by PTT:	800,000
Phone lines installed by other operators:	2.1 million

The Finnish telecoms market has had competition in data networks and services since 1988 with full deregulation of the market taking place in 1994. Since then, Finland has been engaged in an overhaul of its telecoms legislation, in order to meet European norms for post 1998 competition. With over 100 cable television operators and 46 local telephone companies in Finland offering services to relatively small pockets of the population, the opportunity to achieve economies of scale and scope have been limited. There is some consolidation currently underway but all that seems to be achieving is a more dominant position for the Finnish PTT (now called

Sonera) and other telecom operators. The regional private telecommunications companies form a group called Finnet. The Swedish Telia appears as the third competitor. Telia entered the Finnish market by buying a communications company Telivo from Imatran Voima Oy. Recently, there are also other companies offering international phone calls at competitive prices. The development of regional interconnects that currently link some of the cable companies together for programme distribution could be used to transmit telecoms traffic in the future.

Most urban areas in Finland are passed by cable, mainly using tree and branch architecture, although any new network build or upgrading must use a star topology. There is evidence that Finnish cable operators are gearing up to upgrade many of their networks to enhance the return path channels, and develop digital platforms.

Cable television is currently reaching an average of 40 % of all households. This is a relatively high figure. There are urban type communities, where practically 100 % of the households have access to cable television.

There is a migration path to digital television. A lively discussion took place when the most recent Channel 4 was given after a competition. There is an obligation that the recipient will move to digital technology later on. Also the Channel 3 will be offering digital television. The channel 3 is a commercial channel with advertisements.

Digital television is scheduled to start transmission for the general public and to be in production use somewhat before the Sydney Olympic Games in the year 2000. Test transmissions are being done earlier and already now, and prototype receivers exist but not equipment for the general public. The Finnish Broadcasting Corporation YLE has their plans on how they are going to expand their digital network after that. YLE operates national Channels 1 and 2. Also other parties will be active in the digital television broadcasts.

- The number of cable TV customers was increasing about 30 % per year in the 1980's. The driving force was the access to the new TV channels that were offered by the Cable television through Satellites. Recently the growth has been about 4 % per year. The market gets saturated. A new boom can possibly be triggered by the wideband Internet-connection to be offered through the cable-TV system.

- The present analogue cable television is full with the TV channels that are currently offered. In fact the cable TV company has to choose the channels that it makes available. The digital cable TV will be able to offer much more program channels.

- The analogue television broadcasting in Finland, as well as elsewhere in Europe, is expected to continue until the year 2010. Flat plasma displays are expected to be a realistic alternatives for home use after year 2005.

- Helsinki Television, HTV, is the largest cable TV company in Finland, with 200 000 household customers. The developments within Helsinki TV will be examined to illustrate the activities of a Cable TV company.

- Two-way cable TV systems are currently being built. In Helsinki, Helsinki TV has constructed two-way cable TV systems in Pasila (area near the TV centre). In downtown Helsinki two-way system is being built in 1998 and the downtown area is expected to be finished by the end of 1998. Later extensions are planned to

cover the nearby cities of Espoo, Vantaa and Kauniainen. Helsinki TV expects to finish conversion to two-way cable system in the year 2000.

- Cable TV companies in other cities are starting the conversion to a two-way system somewhat later. Because their networks are smaller, they might still be able to finish about the same time.

Tampere is also preparing and starting to build a two-way cable-TV system.
Other cities where cable TV reaches a very large percentage of customers include Oulu, Vaasa and Rovaniemi.

Starting digital television does not require new licences. Thus the existing companies can move to test transmission in digital television on their own initiative. Later on when the activity grows, the licence authorities involved, that is the Council of State and the Ministry of Transport and Communications of Finland have to decide how to organize the activity so as to give equal opportunity to all the actors in the field.

For the open air medium neither the licence policy nor the way of allocating the licences have been decided yet.

- For the cable television, if the cable owners have unallocated capacity available in their cables, this should be made available for other parties at a reasonable cost. There is no difference between analogue and digital transmissions in this respect. New enterprises can enter the cable TV fairly freely now. There will be new legislature coming quite soon. The responsibility of notification will be defined for the cable TV activities. As mentioned above, the capacity of a cable television network can be filled with a selection of analogue channels. Digital TV will make it possible to offer more channels. For example, three analogue channels will have space for 4 digital channels each amounting to 3 x 4 = 12 channels.

If a power company has interests for their own cable network, they would contact the Ministry of Transport and Communications of Finland. For the existing open air networks one can join by paying.

Thus some of the wideband communications participants in Finland include: Helsinki Television, HTV, the largest Cable TV company in Finland.
Sonera (ex Telecom Finland), sold 20 % of its shares to private investors in November 1998.
Finnet
Tampere Cable TV Company, the second largest cable TV company
The Finnish Cable Television Association, FCTA, is also a member of the European Cable Communications Association ECCA.
Nokia Multimedia Network Terminals, a manufacturer of set top boxes and systems.

The two-way traffic for regular open air television broadcasts requires a return channel by telephone or by mobile phone.

Terrestrial television with a return channel on telephone has been used in small scale to receive customer feedback on television programs. Return channel on telephone could also be used for shopping on television, for collecting opinion polls, for educational programs to collect student response, and for other applications of this type.

ADSL is being offered for interested parties by Helsinki Telephone. The current cost is still fairly high for private homes, of the order of USD 500 (FIM 2950) initial cost and 170 (FIM 950) monthly cost. This price information is for the pilot phase, and may change.

- A cable modem access is offered by the Helsinki Television, HTV

- For the cable TV broadband access, the customer needs a cable modem. The cable modem has an asymmetric data transfer capacity, receiving at 30 Mbits/sec and sending at 768 kilobit/sec. The capacity of the cable mentioned will be shared by the customers that are using the channel at the same time.
- When the number of customers increases, one can increase the hardware to get more capacity. The connection between the cable modem and the personal computer is with a 10BaseT Ethernet cable. Thus a 10BaseT Ethernet card is needed at the computer.

- There is cable routing equipment at the main amplifier of the cable network.

- The cable modem system is best suitable for web-surfing. This cable system is not oriented to placing servers for each user in the network. For this purpose, the cable TV company is offering their own web-pages.

- At the customer premises, there are three different ways of connecting between the cable modem and the customer equipment. The cable modem has a 10BaseT cable that can be used.

a) Larger work-stations can be connected with two Ethernet cards
b) a hub router can be used to connect to a LAN
c) a data communications Proxy-Server can be used.

- The cable company can offer their own services on their web-pages. Other companies may also be allowed to place their services on the web-pages of the cable company.

A set top box will be needed to receive digital transmissions with the present day TV receivers. Later on, the set top box functions may become a part of the digital TV set itself. For the time being, changes in the set top box are likely to occur, and it is cheaper to replace the set-top box rather than the whole TV-set.

Set Top Boxes
Set-top box is a device that is used to connect television broadcasts from a cable network or from a satellite to a domestic television set.

d-box
Digital Satellite Reception of German DF1 and Premiere bouquet.
Also reception of clear digital programmes (e.g. ARD, ZDF, etc)
based on DVB standard (Digital Video Broadcasting).
Beta Research Conditional Access, PCMCIA Smart Card
Austria Germany Switzerland
Connectors include:
High Speed Data Interface, 1 x SCSI-2, 50-pin high density
1 x RS-232 (9-pin D-sub), for a printer, PC or a high speed modem.
1 x Telephone (6-pin modular jack)
3 x SCART (TV, SAT, VCR)

Mediamaster 9200S - Free - to -Air
Digital Satellite Reception
No Conditional Access Module
User Friendly Electronic Programme Guide (Nokia unique) on screen
helps to choose the service or can be service provider customised if required.
Software update via Internet.
Connectors include:
1 x RS 232 (9-pin D-sub), max. 19.2 kbits/s
1 x SCSI (50-pin high density), for a CD-ROM player or
other high-speed data equipment, max 3.8 MB/s
Distribution in Europe

Mediamaster 9500S - the Digital Multimedia Terminal
9500S Irdeto CA
Digital Satellite Reception of encrypted and clear programmes
based on DVB standard (Digital Video Broadcasting)
1 x RS 232, max 19.2.kbaud, fax support
1 x SCSI-2
Italy, Benelux

Mediamaster 9600S - The European Common Interface CA
Conditional Access, CA module and Smart Card.
Conax, NSB
Viaccess SVT Europa, Swedish Digital Bouquet,
SRG - the Swiss digital bouquet

Mediamaster 9601S - The Spanish Common Interface Decoder
Digital Satellite Reception of Via Digital on Hispasat 30ºW.
The product will be delivered when subscribing to the Via Digital Bouquet

Mediamaster 9602S - Common Interface CA
- World's first DVB Common Interface Decoder
Distribution in Scandinavia and Finland
1 x Telephone (6-pin modular jack)
1 x RS232 (9-pin D-sub)

Mediamaster 9610S - The Nordic Common Interface Multimedia Terminal
1 x RS232, max 19.2 kbaud, fax support
Return channel:
Connector 6-pin modular jack
V32bis built-in modem which is approved for Norway, Sweden, Denmark and Finland.
Serial data interface:
Connector 9-pin D-sub, RS232, max 19.2 kbaud, fax support
High speed Data Interface: SCSI-2, 50-pin high density

d-box for CATV networks
Digital reception of German DF1 and Premiere bouquet via the Cable TV network
Also reception of clear digital programmes (e.g. ARD, ZDF, etc)
based on DVB standard (Digital Video Broadcasting)
Beta Research Conditional Access (based on IRDETO)
Distribution in Germany and Austria
Mediamaster 9601C - The Spanish Common Interface Decoder
for Cable TV Networks

Mediamaster 9601 C - The Spanish Common Interface Decoder for Cable TV Networks.
Digital Satellite Reception of Via Digital via the cable network. The product will be delivered when subscribing to the Via Digital Bouquet
Via Digital
Available in Spain

9850T
for digital terrestrial services UK
CA systems: embedded Mediaguard with smart card reader and Common Interface with (PCMCIA) connector
Ready for Pay per View services
Prepared for interactive services
Built-in telephone modem
Return channel:
Connector 6-pin modular jack
Protocol V22 bis
Serial data interface
Connector 9-pin D-sub
Signals RS232

Thus the connectors available seem to be all or some of the following:
RS-232 (9-pin D-sub), max. 19.2 kbaud
SCSI, 50 pin, max. 3.8 MB/s
Telephone
SCART

The SCSI connector can be used to connect a disk memory. This could be used for storing a video program on the disk.

The set top boxes listed above are some of the currently available products. There will be further new products available in the future.

A Smart Card comes from a Service provider of your choice. The Service Provider is the distributor of the programmes. If you are subscribing to services from more than one service provider you may need to change between different Smart Cards, or even between different CA Modules.

Cost estimates for set top boxes run from 1000 FIM (about USD 200, about 110 pounds) upwards, though this lowest price is not very likely at the beginning.

- The cable modem can be rented for USD 50 per month. There is also an initial cost of USD 50.
- LON networks have been installed to some locations. Equipment for buildings, equipped with LON interface has been designed, and is being manufactured and installed by some companies in Finland.

According to the Finnish national broadcasting company (YLE) the construction of a digital TV and radio distribution system will start in 1998-1999. A digital radio channel has been tested since 1994 and operating regularly since October 1998, five YLE radio channels are available digitally from 1999 on, and two channels more in 2000. A DVB-S satellite TV channel and two digital radio channels have been operating since 1997. The networks will cover most of the country within about five years. Digitalised TV and radio networks are expected to spread to about half of all users within ten years of their initial introduction.

Household connections to the information highway
Households will be linked to the information highway through fast DSL connections using telephone cables, digitalised, two-way cable TV systems, and digital TV networks supplemented with a return channel through the telecommunications network, for instance. DSL connections and two-way cable TV networks will start to be common towards the end of the century.

Broadband fixed connections and digital TV and radio networks will compete for the distribution and use of radio and TV services and data network services. Anyhow within the next ten years, radio and TV programmes will primarily be distributed through the present analogue and digitalised radio and TV networks. An ever-growing range of personal communications will rely on fixed connecting networks. Competition between digital TV and radio networks and the fixed telecommunications infrastructure will be toughest in interactive entertainments and services, and in the provision of information.

Various networked terminals will come on to the market as rivals to the PC. These will have more limited properties than a personal computer, but will be cheaper for certain purposes.

The boundary between the PC and the TV will be blurred as terminal systems become
increasingly integrated. Various of the properties of the TV will be added to the PC, and vice versa: the user interface will be much the same, involving a cordless keyboard, a remote control with a mouse, and a return channel for interactive services via the telecommunications network, for instance.

There will be more sources of information, and data will be more individualized. The interactive principle will be incorporated into digital TV and radio programmes, that is, users will be able to influence the content of the information they receive and search for further data. In information retrieval, information networks will more commonly feature search systems based on a wide range of agents. Users will be able, for instance, to select news, hobby and product areas, where the agents will search for information packages.

3.2.3 The Netherlands

Area:	41,160 sq km
GDP:	US $432 billion
Population:	15.4 million
Total households:	6.8 million
Total TV households:	6.6 million
No. of cable operators:	169
Homes passed by cable:	6.1 million
Homes subscribed to cable:	5.7 million
Homes subscribing to DTH/SMATV:	375,000
Phone lines installed:	7.8 million

The Dutch government's long awaited Telecommunications Bill eventually saw the light of day in November 1995. In a move that was criticised by the European Commission, it proposed to give only one operator construction rights to build a national competitive network. The Bill did however give local and regional operators the right to upgrade their networks to provide full services.

The November 1995 Bill has since been supplemented by the Interim Act to liberalise alternative infrastructure and set up an independent national regulator. Based on the legislation, there will be two national licences and up to 1200 regional concession licences issued to provide competitive service to companies that already have their own networks.

The Netherlands remains one of the most densely cabled countries in Europe and the opportunities for cable operators to develop their own programming and channel tiering as well as offer telephony services are excellent.

Although at present PTT Telecom Netherlands maintains the monopoly on voice services, the Dutch government invited bids for licences to run fixed telecom services. Two national licences were awarded late in 1996 to Enertel the consortium of cable and energy companies and Telfort the joint venture of BT and Nederlands Spoorwegen (Dutch national railway). At the present time there are serious disputes between these new operators and the Dutch government over interconnection rates and access charges.

Also PTT Telecom Netherlands has announced it will spin off the majority of its subsidiary, KPN Kabel, following pressure from the Dutch government. KPN Kabel included amongst its operations a 77% stake in the largest Dutch operator Casema, which would not have been considered for a regional telecommunications (telecoms) licence if the PTT retained so much management and operational influence.

Dutch cable networks are among the oldest in Europe with a limited bandwidth, restricting capacity to about 30 channels. Because the networks are primarily owned by municipalities there is currently little funding available to upgrade them for value added services or telephony.

One company that has committed already to upgrade and offer telephony services is A2000, which has received a regional telecoms licence and finalised an interconnect agreement with KPN, and will start a non voice telephony service in July 1998.

The plan for most of these networks is to sell them off to commercial bidders, and it is expected that many of the bidders will be utility companies who will be able to afford to upgrade the existing networks.

Cable Television Network: Today 80 to 90% of the Dutch customer population is connected to a CTV grid. In highly concentrated areas, like cities, this percentage is usually almost 100%. The present utilities are the owners of about 50% of the national existing CTV networks. The item Cable Tele Vision is very attractive for both the utilities (financial profits) and its customers (high quality entertainment). More and more CTV network owners are introducing new telephone services, inclusive (cheap) Internet facilities, to their customers. In other words: the CTV companies are in competition with telephone companies.

Almost 50% of the utilities does not own a CTV network. At these utilities is a strong interest in using their existing electricity grids for telecommunication. An example is the north Dutch utility EDON which have a contract with NORTEL for development of high speed data-communication facilities across the (low voltage) network to the connected customer supply points. The favourite applications are (expected) cheap telephone and Internet services. However, there are still a lot of problems to solve like good quality of the signals, EMC and normalisation requirements

3.2.4 Norway

Area:	386,000 sq km
GDP:	US $163 billion
Population:	4.4 million
Total households:	2.1 million
Total TV households	1.77 million
No. of cable operators:	35
Homes passed by cable:	870,000
Homes subscribed to cable:	710,000
Homes subscribing to DTH/SMATV:	370,000
VCR homes:	1.25 million
Phone lines installed:	2.36 million

The Norwegian cable market is relatively small with only 47% of Norway's 1.77 million homes being passed by cable, but with a very high penetration of 81.6% (710,000) where consumers have access to the network.

Cable operators in Norway have a fairly unique regulation placed upon them by the local broadcasting authorities that puts programme choice into the subscriber's hands. If subscribers are not satisfied with a cable channel it has to be removed from the network. This to some extent restricts the multi-channel offerings from the cable community and reduces the validity of cable delivery. This may be the reason for the very rapid growth in the satellite DTH market in Norway.
In discussion with the Norwegian regulators earlier in 1998, there was much talk about consolidation of the 35 cable operators in an attempt to build a commercial and economic foundation from which to launch new services. Many of the current networks are no more than upgraded SMATV systems with very few subscribers.

Canal + Gul (yellow) a Scandinavian/Nordic channel and a local version of Canal + for each country are the programmers to watch. Canal + has now teamed up with Norway's PTT Telenor to launch a digital platform, with their only major competitor TV1000 announcing that they will not be joining the digital race, but concentrate on their analogue services.

PCTVnet ASA from Norway has developed a smart home concept based on the use of TV as a customer interface by using a configurable and extensive set-top box (HomePilot) with a multifunctional approach. This concept gives the opportunity for energy control and use of Internet with the television set as the interface towards the user. The set-top box is controlled from a wireless HomePilot-keyboard. The connection to Internet is established via analogue telephone, ISDN, ADSL, Ethernet and Digital-TV decoding.

The HomePilot has a built-in architecture that enables it to communicate with other electrical devices in the home through the electrical wiring system already in place. However, to be fully functional, the service has to be enabled by inserting an Echelon control card in one of the PCMCIA ports in the back of the HomePilot.

The HomePilot is being prepared for the digital broadcasting, Internet telephony, and Smart card based payment functionality to make home shopping more convenient.

Together with Echelon, a set of devices for home automation has been developed. Among these are a 300 W controller for lights and a 3000 W controller for power consuming equipment such as hot water heaters, electrical heating panels, washing

machines and dryers. Technical specifications: Memory 8Mb RAM, Operating System QNX, Processor Elan SC400 and a 33,6k Modem.

A prototype of HomePilot was tested in 15 households in Norway, and the participants were asked what they where willing to pay for this system. In average the customers where willing to pay about 20 USD (150 NOK) for each node, and for the system with the functions that are mentioned here they where willing to pay 200 USD (1 500 NOK). PCTVnet has changed protocol for communication from Echelon to X-10.

Iridium

Iridium is a system for satellite communication. 66 satellites are used to get a global system, in addition to 11 earth stations. Iridium gives you the ability to communicate from wherever you are. With a single phone number and a telephone Iridium offers you the ability to stay connected anywhere on Earth.

The phone needs to be a special terminal for use with the satellite network. This terminal can also be used in the GSM-network, and you need a GSM-card. The price of the terminal is about 2 700 USD (20 000 NOK). Iridium was introduced on 1 November 1998 and the distribution is limited.

The earth is divided into 15 tariff-zones and the price for using the terminal varies between 2 and 5 dollars/minute. Iridium has got the frequency band 1,4-1,6 GHz which gives a transfer rate at 2 600 baud.

Iridium has made an agreement with NetCom GSM and Telenor Mobil, which gives the Norwegian users the opportunity for global covering via their mobile telephone.

Telenor Avidi

Telenor Avidi is a part of Telenor and provides cable television for households. Telenor Avidi is one of the largest suppliers of sound and picture in Norway.

Today several places in Norway have the ability to use Internet with the television as interface. This gives the opportunity to surf on Internet without paying any fee per minute and it is also faster than both telephone and ISDN.

The amount the customers pay when purchasing cable-TV include:

- Subscription for cable-TV (includes service, maintenance and inspection)
- Program fee and charges to the government
- Hire for the decoder (if pay-TV wanted)

The prices for subscription of cable-TV are:

- Full subscription A: 1 000 USD (7 300 NOK) plus 220 USD (1 618 NOK) per year
- Restricted subscription B: 400 USD (2 900 NOK) plus 76 USD (567 NOK) per year
- Rate per month in addition to above annual rates:-
  25 USD (<NOK 200)

Janco Multicom

Janco Multicom is a Norwegian company that provides cable television for households. Janco Multicom is connected to 320 000 customers, and another 140 000 customers can easily be connected to the network.

From 1999 Janco Multicom will offer telephony via the already existing infrastructure (the television cables). The customers will receive two telephone channels - the same as with ISDN. The difference is that the Internet-connection is much faster. The capacity is 2 Mbit/s.

The coax cable for CATV has a large capacity. It is possible to transmit at least 50 TV-channels at the same time, in addition to high-speed Internet, telephony and other services.

The CATV-company also offers Internet via cable-TV, and the company can deliver, install and test all the equipment you need for only 175 USD (1 300 NOK).

EAB Tele AS

EAB Tele AS is one of the subsidiary companies for the netowner Energiselskapet Asker og Bærum AS. EAB Tele AS is working with development of new services and products to offer for their customers after the monopoly for telephone was cancelled in 1998. Two main services are Internet over the cable-TV-network and Teleworking. EAB Tele is also supposed to develop the offer for cable-TV in Bærum.

EAB Tele AS offers their products/services under the name: *alfa*NETT (previous "Bærum cable-TV").

*alfa*NETT offers four different products for Internet over the cable network. The difference is mostly in the price. The customers have to pay a fee for establishment of all four products. This fee is about 95 USD (695 NOK). The products are:

Category	**Rate**	**Price/Year**
Hobby	256/256 kbps (symm.)	566 USD (4 188 NOK)
Plus	512/512 kbps (symm.)	800 USD (5 940 NOK)
Prof.	2048/768 kbps (asymm.)	2 900 USD (21 540 NOK)
Super User	10 /1,6 Mbps (asymm.)	9 250 USD (68 400 NOK)

The different categories include modem for the cable, e-mail, 10 MB for a private homepage, SOL-membership and free use all day.

*alfa*NETT has a bandwidth of 100 Mbps on private lines connected to Oslo, and a bandwidth of 2 Mbps to foreign countries. These lines will be upgraded when needed.

EAB Tele can not offer Internet to all their customers with cable-TV, because their network needs a technical upgrading. This work has started.

Telenor ADSL

Telenor Nett AS has started a trial project about broadband Internet access using ADSL (Asymmetric Digital Subscriber Line) technology. This project is in conjunction with Telenor Nextel and Telia, and this product is accommodated for the industry market.

ADSL technology facilitates rapid transfer of data, telephony services and ISDN over the same copper wires that run into houses or workplaces. Data is transferred asymmetrically, which means that the link from the Internet to the user has higher speed/greater band width than the link running in the opposite direction.

The object of the project is to test out the technical functionality of existing and forthcoming equipment, testing the quality and performance of lines (telephone lines to customers), testing the provision of various services through the same cable in terms of crossed lines/interference (ADSL, ISDN, HDSL, etc.).

In the course of the trial period, Telenor Nett AS will test speeds of up to 2 Mbit/s to customers and 640 kbit/s from customers. ISDN/telephony traffic will be separated at the central switchboard and sent on to the ordinary telephone network. Data traffic travels outside the telephone network and into the Internet suppliers' network.

Digital Radio - DAB
DAB means Digital Audio Broadcasting, which gives a better sound quality and more channels than today's FM-radio. DAB was launched for the first time at the international exhibition for consumer electronics, IFA, in Berlin in September 1997. The first consumer radio will be sold in Norway in 1998.

Since the spring 1994 test broadcasting with DAB has been worked out in the Oslo-area (Norway). The main channels at NRK (P1, P2 and Petre) and P4 have been broadcasting in parallel on the FM-network and DAB. In autumn 1997 about one million people in Norway are able to receive DAB. These people are located at the eastern part of Norway, and they represent 30% of the population.

A digital network for radio opens up for several channels more than the existing FM-network. When DAB is extended in Norway there will be one network for the whole country and 7 region networks. These regions will include 3 counties.

DAB was originally developed to perform sound with the same quality as a CD player to mobile receivers with a speed up to 200 km/t. The frequency band 223-240 MHz is dedicated to DAB. Originally DAB has a capacity for 2 304 kbps, but because a lot of the capacity is used to protect the transmission, the effective capacity is normally between 1.1-1.3 Mbps.

Benefits with DAB are:

· **Super sound**	- Improved sound quality - No receiver noise
· **Easy to handle**	- Each channel has the same frequencies through the whole country - Easy to program the radio on specified programs
· **Several alternatives**	- Increased options of programs - Ability to program a personal "radio-day"
· **Several additional services**	- Possibility to send different kinds of digital information - Receive text-information (e.g. about the traffic, weather, restaurants)

Combined receivers for FM and DAB entered the market in 1997. In the next years radio channels will transmit on both FM and DAB, but the network for FM will probably be built down from the year 2010 and later.

Digital Television - DVB
DVB means Digital Video Broadcasting - a digital version of the television signals. DVB will be introduced on all communication media for television, i.e. satellite, cable and ground net. The standards for the different communication media are respectively DVB-S, DVB-C and DVB-T.

For the first year digital television will be offered to the customers through set-top boxes, which probably will cost about 675-1 350 USD (5-10 000 NOK) or the customers can hire it on a monthly basis.

DVB-T has an effective capacity for about 5-32 Mbps, and the lowest capacity gives the most robust transmission. The frequency band is 470-862 which the digital TV has to share with the analogue TV-signals.

In Norway technical tests of DVB will start in 1998. The digitalisation of the TV signals opens for more channels, multimedia and intelligent receivers. These again give the opportunity for Internet and telephony via the television set, and services like Electronic Program Guide (EPG), "Pay per view", Interactive television and Near Video on Demand (NVOD).

Telenor Plus and the French Canal Plus co-operate in the company Canal Digital. This company will offer a decoder for about 675 USD (5 000 NOK) or to hire on a monthly basis. This offer will only be for customers who already have a parabolic aerial. This decoder will give the customers access to 32 digital television channels, 24 channels for "pay per view", "Near Video on Demand" (NVOD), 20 digital channels for music and home shopping, Internet and other services.

Today People in France already have the opportunity to watch up to seven football-matches on television at the same time! When there is a goal in one match, the customers hear a sound and can change channel. To see one match costs 8 USD (62 NOK) and seven matches cost 12 USD (87 NOK).

A search done on behalf of the company ViaSat shows that the Norwegian market is sceptical about digital television. This is primarily due to high costs, restricted offer of programs and uncertainty about standards. In 1997, 60 000 analogue parabolic aerials where sold in Norway, and only 200 digital. The opinion in the market is that the costs for digital equipment will be reduced sufficiently to capture the market in five years.

3.2.5 Spain

Area:	504,800 sq km
GDP:	US $610 billion
Population:	39.3 million
Total TV households	11.8 million
No. of cable operators	28
Homes passed by cable:	1,200,000
Homes subscribed to cable:	450,000
Homes subscribing to DTH/SMATV:	750,000
Phone lines installed:	16.9 million

Although the Spanish telecommunications/cable law was passed in December 1995, the cable community had to wait until 1997 for the technical regulations. These proved to be a severe disappointment to the potential investors in cable communications.

The problem is that although the Spanish government is advertising franchises for independent cable services, Telefonica, (the Spanish PTT) is to be allowed to compete with the franchise holder within 16 months of the award of the franchise if they so choose. This is a major issue that looks likely to hinder significant roll out of cable infrastructure.

Nonetheless, 1 December 1998 heralded the full deregulation of Spain's telecoms sector. Previously, the Spanish government, under a great deal of pressure from the European Commission, had licensed only one additional fixed line operator called Retevision, a state owned TV transmission company, which began providing services at the beginning of 1998. A third licence has been sold at the end of 1998 to a new operator called UNI2.

With the exception of one or two cable operators, investors have been waiting for signs of a stable regulatory climate before committing themselves to rolling out networks.

In Spain, utilities have already built wideband infrastructure and they will continue to do so. They have installed optical fibre on overhead lines and underground cables. There is a very important investment made on this subject. But utilities do not operate this infrastructure; they rent or lease it to telephone operators or cable operators.

Besides that, it is mostly thought that electricity utilities will stick to the energy business and will use communications only for things related to this business. At the most they are going to invest in communication utilities (they are already doing that).

Services and functions that electricity utilities intend to do with their customers require narrowband communications only, even if they use Internet. With this assumption a narrowband medium and gateway could be useful for a long time.

Many cable TV operators are now starting businesses in Spain. There is at least one for every Region. That totals more than 20 CATV operators. They get a licence for 25 years and commit to have the main cities 100% cabled in 5 years.

All TV will have to be digital, but penetration is estimated to be initially only 15% in five years. At the beginning it will be mostly satellite but it will turn to cable progressively.

Although radio systems for residential customers are not currently developed, there are opinions that it can be the system of the future for the last mile to the customer premises.

Third party access is legal in Spain. This means that an operator is forced to allow its infrastructure to be used by another company to provide some communications services, e.g. the old monopolistic Telephone Company has to allow its competitors to use its infrastructure.

With CATV, low data need services could be carried out using the "return channel." For ADSL, Broadband Radio and LEO, the main channel will have to be used.

In the long run it could be useful for the customer to have a unique gateway for all services. However it is thought that the low speed bus can last until its equipment gets obsolete, if it really does so.

TV and telephone services are being developed by all cable operators (more than 20) and the three existing fixed telephone operators.

Telephone operators are currently testing ADSL on twisted pair with different manufacturers: ALCATEL, Siemens, Ericsson, etc. The dominant telephone operator is testing ADSL technology on twisted pairs in a pilot project with customers. The first phase of this project ended in December 1998.

The current development of ADSL technology puts a serious thread to cable operators in Spain. There are news that the Government is studying to allow any ADSL operator to hire, for ADSL exclusive use, the traditional telephone twisted pair connections of customers that choose this option. This makes cable operators to be really worried.

As it has been seen, all available wideband technologies are being deployed simultaneously in Spain, what may be a risk not incurred in other countries where cable is already well implanted.

The pilot ADSL project uses ADSL modems providing an Ethernet access at 10 Mbit/s at the customer side. (The link itself is 2/6 Mbit/s.)

The other technologies are using set-top boxes.

In-house wideband networking is negligible in Spain.

In modern houses, the telephone twisted pair and the TV coaxial cable (downlink only) is installed in most rooms. So that this is the basic “wideband” access for Internet or TV.

Security cameras are normally connected by the classical telephone network.

Set-top boxes could cost between 30,000 and 50,000 Spanish Pesetas (between 200 and 300 Euros).

The pay-per-view charge for a football match is 1,000 Pesetas (7 Euros) and for a movie is 800 Pesetas (5 Euros).

There are several standard and proprietary proposals about in-house communication architectures. Most probably it is too early to find out which will prevail. The cabling in a house can be done when building it. In this case possibly a wideband cabling based on coax or twisted pair cables is the option. In existing dwellings it will be important to use existing cablings. Here the low voltage cabling may be the option. It is already deployed and there are plugs in every room. It can even connect to the exterior (to the room concentrating the meters). Nevertheless, several hurdles, are yet to be overcome to deploy this technology.

3.2.6 United Kingdom

Area:	244,111 sq km
Population:	58.5 million
Total households:	24.5 million
Operating franchises:	118
Total TV households:	23.5 million
No. of cable operators (MSOs):	5

Homes passed by cable:	9.7 million
Homes subscribed to cable:	2.15 million
Homes subscribing to DTH/SMATV:	4.2 million
VCR homes	19.1 million
Phone lines installed by PTT	27 million
Phone lines installed by cable operators:	2.9 million

It is difficult to analyse the successes and failures of the UK's cable and telecommunication's policy. The whole concept of liberalisation was introduced in 1984, but it is only now in the late-nineties that residential consumers are seeing the value of competition.

The opportunity for cable operators to offer telephony at the local loop has helped drive cable networks into the ground, and the fact that there existed two competing long distance networks created a business opportunity for them that will probably never be replicated across Europe. As more long distance telecom operators emerge the commercial opportunities for cable telephony continue to increase.

For cable operators the industry has been a roller-coaster ride with poor cable TV penetration that has been stuck at just over 20 per cent for years, but with excellent results in telephone penetration. Recent initiatives to unbundle programming, however, hint at improvements to come. In the UK the name of the game is consolidation to gain the economies of scale and scope that are vital in the new communications market. The move by Cable and Wireless shocked industry watchers with its speed, surprise and audacity and created a super MSO in the shape of Cable and Wireless Communications and took out three major MSOs at the same time. With NTL and Telewest currently battling for supremacy, the market will continue to be active.

For the Direct to Home (DTH) market, Astra is the key with British Sky Broadcasting Ltd (BSkyB) dominating the market and Flextech following a long way behind. The recent announcement about unbundling channels will probably assist BSkyB in its quest for digital dominance. Although Flextech has pursued a strategy of negotiating carriage on every digital platform and has its deal with probably the best broadcasting brand in the world, the BBC, the going will remain hard while the environment remains largely analogue.

The big question is how will BSkyB fare in launching its digital service against the forthcoming terrestrial digital offerings, and what strategy will the cable industry implement.
Programming in cable networks is a key issue, with the current market dominated by BSkyB and analogue networks at full capacity.

BSkyB is a wholly-owned subsidiary of British Sky Broadcasting Group plc. News Corporation owns 39.88% of the shares of BSkyB Group plc's shares. The BSkyB group was formed in 1990 by a merger between Sky Television Limited (formerly plc) (then a News Corporation subsidiary) and its then competitor British Satellite Broadcasting Limited.

BSkyB is a broadcaster of analogue pay-television services delivered by the Astra satellites for direct-to-home (DTH) and cable reception in the UK and Ireland. BSkyB operates at both retail and wholesale levels in these areas. BSkyB intends to launch a digital pay-TV service during 1998.

The TV Standards Directive 95/47/EC, implemented in the UK by legislation and by statutory instrument, contains three elements relevant to the present case:

- **conditional access:** suppliers of CA services for digital television broadcast services must supply CA on fair, reasonable and non-discriminatory terms,
- **transmission signals:** the Directive standardises the transmission signals for digital television broadcasting in the EU. The transmission standards are different, depending on the transmission mechanism chosen, satellite, cable, digital terrestrial: the demodulation standards are therefore also different,
- **set top box specifications:** the Directive deals with certain minimum characteristics for set top boxes, for example, all set top boxes must be capable of receiving free-to-air (i.e. unencrypted) television signals. There is no obligation to include a common interface within set top boxes. The absence of a common interface means that the set top box is tied to a particular conditional access system, unless the set top box manufacturer includes in the set top box specific means to another access system.

The obligations in the TV standards Directive relating to conditional access services are limited in scope to the provision of conditional access for digital television services. However, conditional access will be used for some non-broadcast (i.e. on-line) services. The UK regulatory regime refers to the provision of conditional access for these services as access control services. A class licence for the provision of access control services has been established by OFTEL (Telecommunications Regulator) and the DTI. (Department of Trade and Industry).

Recently a joint venture company, British Interactive Broadcasting, has been established to pursue interactive business. The shareholdings in the joint venture Bib will be as follows: BSkyB, 32.5%, BT, 32.5%, Midlands, 20% and Matsushita, 15%. The Board will consist of 10 Directors: three appointed by BSkyB, three by BT, two by Midlands two by Matsushita. BiB has been established for an indefinite duration and will be jointly controlled by its parent companies.

The purpose of joint venture BiB is to set up the infrastructure necessary for the provision of digital interactive TV services to consumers in the UK and to provide such services to consumers using that infrastructure.

The BiB digital interactive TV service will thus allow content providers to offer their goods and services directly to digital TV viewers and to complete transactions with such viewers. The service will combine content broadcast via digital satellite (broadcast content) with, in some circumstances, content delivered via a standard domestic telephone line (on-line content). Any telephone line can be used for this purpose. In addition, the parties indicated that they intended to enter negotiations with a view to making the BiB service available alongside the digital broadcast entertainment services transmitted on digital terrestrial and digital cable in the UK.

The following services are expected to be provided over the BiB platform: home banking, home shopping, holiday and travel services, down-loading of games, learning on-line, entertainment and leisure, sports, motor world, a limited collection of 'walled garden' Internet sites provided by a third party and e-mail and public services. BiB's services will generally be available free to customers with the exception of down-loading of games, learning on-line and limited Internet access for which a separate fee will be charged.

An essential part of the BiB infrastructure is a digital interactive set top box: each consumer must install such a box in order to access the BiB service. BiB's largest business cost over the first 10 years of its operation will consist in subsidising the retail price of BiB compatible set top boxes and digital satellite dishes, including the installation of those boxes and satellite reception equipment in consumers' homes. The digital interactive set top boxes subsidised by BiB are those specified by BSkyB, with input from the other BiB parties, for its digital pay-TV service and for interactive services. These boxes will allow consumers to interact with broadcast content, rather than simply being passive viewers of a broadcast. There are broadly two forms of interactivity enabled by the infrastructure to be set up by BiB. First, the BiB infrastructure allows for Internet-like, on-line services to be delivered via television screens such as those to be provided by BiB. Secondly, interactivity can be added to broadcast programmes (for example, participation in quiz shows) or broadcast advertising (for example, the provision of additional information either via the television screen, or by placing an order for a brochure to be mailed).

The BiB infrastructure will allow both digital broadcast data signals and digital on-line data signals to be decoded by authorised viewers for display on the current generation of analogue television sets and future sets envisaged by the advanced television standards Directive and to allow these viewers to transact in a secure environment. BiB will offer its infrastructure to both digital TV broadcasters, such as BSkyB, and providers of digital interactive TV services, such as BiB Services Co. It has been set up specifically with the provision of broadcast content via satellite in mind.

The set top box includes a 28.8 kbps modem.

The joint venture agreement provides that BiB will subsidise the retail price of 'box packages' in order to bring down the retail price of such box packages to what the parties consider to be an affordable price point below 125 US$ including VAT.

BSkyB, with input from the BiB parties, has specified a digital interactive set top box which embeds BSkyB's proprietary conditional access (CA) and access control (AC) systems and BSkyB has ordered such boxes from manufacturers. As the box does not contain a common interface, this means that it is tied to BSkyB's CA and AC systems. The box includes a digital satellite demodulator and has interface ports on to which digital cable, digital terrestrial and broadband telecommunications network "side car" demodulators could be attached. This means that BiB compatible boxes could be used with all transmission systems if such "side cars" were attached.

The application programming interface (API) in the box is supplied by Open TV (formerly Thomson Sun Interactive). BSkyB has commissioned Open TV to develop enhancements to the Open TV API (agreement BSkyB/Open TV). These enhancements allow the box to decode high quality still pictures broadcast via satellite (MPEG or JPEG) in addition to moving pictures (MPEG); the quality of sound via PSTN (on-line) is improved (G729 audio) and finally they allow the API to 'talk' to the interface modules (whether for alternative demodulator side cars, games consoles and so on).

'Simulcrypt': means the use of the European common scrambling algorithm in two populations of digital television decoders. Each population contains a different conditional access technology. Simulcrypt allows retailers of digital television services to offer their services to consumers.

BSkyB agrees that the subscription price for packages of digital satellite entertainment services will be no higher than the subscription price of similar analogue packages of satellite entertainment services. BSkyB also agrees to use reasonable endeavours to ensure that all programmes broadcast on BSkyB's analogue satellite service will be broadcast simultaneously on BSkyB's digital satellite service.

There appears to be no lock-in where customers are tied into a simple operator, for consumers who have purchased satellite decoder equipment and/or dishes. UK cable operators offer to buy back such equipment should consumers choose to take a cable service or alternatively make special offers, comprising, for example, free connection to the cable network, free telephone line rental, free installation of a second set top box and a free cable guide magazine.

There is a demand from consumers for telecommunications services: in the past the demand was almost exclusively for voice telephony services, although more recently demand for data services, such as Internet access, has grown significantly. In order to provide these services to consumers, it is necessary to use infrastructures capable of providing these services into the home.

The fact that telecommunications services generally involve two-way communication imposes a constraint on the types of infrastructure that can be used for these services. Historically that demand could only be fulfilled by a copper based public switched telecommunications network, although in recent years alternative access mechanisms, such as cable TV networks, and wireless networks have developed.

Third Party Access - Where BSkyB/SSSL permits a third party to sign interactive applications for transmission to BiB boxes it will offer such right to others requesting the same, on fair and reasonable terms and on a non-discriminatory basis. This shall include a requirement on such third parties to meet the technical, commercial and financial criteria.

4 Discussion of Options for Customer/ Utilities Services Provision

Within this technology and business environment for providing wideband communications services for customers, there is a need to consider where and how utility/customer services can be accommodated and whether advantage can be taken of potential opportunities for using the infrastructure at low cost.

Rapid development is also taking place in local area network (LAN) technologies, mainly for linking together shared computing networks for commercial and industrial applications within buildings with projected deployment of fibre to the desk within the next five years. Part of this communications development involves the development of medium speed (10M baud) system protocols using twisted pair and coax for use in residential buildings for computer and peripheral interconnection, surveillance and entertainment purposes. An illustration of a wideband in home architecture is shown in Figure 2.

At the bottom of the communication techno-economic chain are relatively narrowband "in-house" communication systems (20K baud) for intelligent home control, thermostat temperature sensing etc. Low installed cost is absolutely paramount for these applications as is also powerful "plug and play" capability to enable customers to install their own devices.

These narrowband systems generally use the electricity mains wiring in the home or twisted pair installed specifically for the purposes of communication. Pico cellular radio is also being developed for this application and is likely to be a serious competitor in the near future.

The results of customer/utility services requirements evaluation carried out in Annex II, Sub Task 7, showed that all the services that were envisaged as being provided by utility businesses, as opposed to separate communication businesses owned by utilities, could be implemented using narrowband (≅ 1000 baud) communications between customers and utilities. The specification for the flexible customer gateway included several media and protocols to enable the provision of services using different local area networks within customer homes. This could be, for example, to accommodate security sensors using twisted pair, remote metering using Mbus or energy management using LON, EHS or CEBus.

Communications external to the home can be provided by means of narrowband communication media such as PSTN, narrowband radio or power line. The specification for the flexible gateway developed in Sub Task 7 allowed for any of these media and their associated protocols to be implemented. It also allowed for the provision of plug in daughter boards to link the gateway and customer applications to wideband "external to the home" communication media. It is likely that one or more narrowband busses within customer premises will be the most cost effective way of implementing utility services within residential customer premises in the foreseeable future. Consequently irrespective of the "external to the home" communication medium used, a narrowband gateway will always be required to link the external to the home medium to the customer bus. Identifying the likely availability of that external link using wideband media, the connection to it and the likely costs involved are the purposes of this evaluation. This will enable utilities to determine cost effective strategies for providing services and to balance the timescale requirements for services against the growth of wideband media availability. Utilities wishing to provide services requiring communication are faced with deciding whether to use or invest in narrowband communication infrastructures or to invest in or use wideband infrastructures when it becomes available to the average residential customer. In order to assist with that evaluation, it is important to understand what would be involved from a technical perspective in providing two way, narrowband services using wideband communication media.

The wideband media which are important in this evaluation are:

(a) wideband telephone networks (ADSL)
(b) satellite
(c) fibre/coax cable
(d) terrestrial broadcasting

The costs of using telephone networks and other narrowband media for the provision of utility services to a customer population are evaluated in Chapter 5 using the eaCOMMS model (reference 2). There is no reason to believe that using enhanced speed telephone networks upgraded for wideband services would reduce the costs of providing the narrowband services. The converse may well be the case.

As outlined in Chapter 3, the move to digital wideband services using satellite, fibre coax and terrestrial media is taking place quickly with many countries introducing digital TV broadcasts in 1999. Plans in some countries to phase out analogue broadcasts in ten years means that only the digital option is worthy of evaluation as a means of providing long term utility services using wideband media. The basket of

required utility services defined in Chapter 2 included broadcast services, one way individual customer services and two way individual customer services. All the above wideband media can accommodate broadcast and one way individual customer services. Terrestrial and satellite transmission require a separate medium such as telephone to obtain a return path. Developments are however well advanced to use these media in a two way mode. The drivers for all these two way developments is interactive television, video on demand and Internet access, as have already been described.

In order for customers to receive direct to home satellite digital broadcasts and ultimately two way broadcasts, a set top box (STB) and receiving dish are required. A similar STB is required to enable customers to receive terrestrial digital broadcasts. A cable modem is required in order for customer to receive digital CATV and also exchange information on fibre/coax networks. In the UK and to a limited extent in some other countries, a separate twisted pair cable has been overlaid with the fibre/coax network to facilitate the provision of telephony services. Two separate communication infrastructures are operated side by side in the local loop. It is not obvious which would be the most cost effective of these two options for the provision of utility services. The twisted pair option will result in costs comparable to those for telephony services. The use of the control channel spectrum on the fibre coax network is the alternative and costs have been estimated for this evaluation.

The set top boxes used by satellite and terrestrial broadcasts are at present incompatible with each other. “Sidecar”, input modules are however being developed to enable terrestrial receiving devices to be upgraded to satellite also. The cable modems used by CATV and other service providers using fibre/coax networks are incompatible with set top boxes and in many cases between different cable companies.

The long term future for digital television and wideband customer services at an economic price is the development of an integrated home gateway product to allow customers to use all wideband media or make a selection. However this requires convergence between competing technologies as is not envisaged for some time.

Cable services suppliers regard Internet access provision and telephony as the major business expansion drivers for the immediate future which they can provide most effectively to complement digital television packages. In most countries the 5-40MHz control channel is used for return communication for these applications. Terrestrial and satellite service providers see interactive entertainment as the major driver in their market with return path via telephone. This also allows reasonably rapid Internet access with asymmetric data rates in the two directions. This however is not regarded as the major driver for obvious reasons of return path costs. Tests of using radio return path are being tried but this is technically challenging with transmitters located at customer premises. However the use of wideband radio for two way data transmission is likely to be a contender in the near future but may be difficult to justify for fixed premises as well as mobile applications.

From the perspective of this evaluation, the use of terrestrial or satellite with telephone return channel is likely to result in costs at least similar to those for using PSTN networks. However the benefit of using a broadcast medium for communication between services supplier and customer, such as satellite or terrestrial, would be to remove some of the problems of broadcasting services using the PSTN.

The development of telephone networks for the purposes of providing wideband two way communications has been outlined in Chapter 3. It is unlikely that the costs of using this service for the provision of narrowband customer/utility services will be lower than for PSTN networks.

From the perspective of providing customer/utility services, it is important to ensure that the narrowband modem, used to link the wideband medium to the narrowband bus, within the customer premises, has the required flexibility to deal with different external wideband media. The gateway specified in Sub Task 7 would accommodate this by including a daughter board to suit the particular wideband medium being used. If the medium was changed, a replacement board to interface the new medium would be required. An illustration architecture linking the wideband, Set Top Box or cable modem to the narrowband customer/utility services bus within the home is presented in Figure 3. The link between the Set Top Box/Cable modem and the flexible gateway use RS232 or USB protocols which are readily available on commercial, wideband media devices.

Using cable operators infrastructure and a narrowband gateway to interface to set top boxes could provide two different possibilities. In the UK, the use of the separate twisted pair link into the PSTN would be likely to result in similar service costs to that of the PSTN itself. It may be possible to use the HFC network, 5-40MHz band for the services with the utility/service provider obtaining access to the CATV head end. Estimation of the relative costs of providing the required customer/utility services using narrowband or wideband infrastructures external to customer premises has been carried out in order to determine the most appropriate business strategies.

5 Evaluation of Strategy Options

There are no technical reasons why narrowband utility services cannot be provided by each of the wideband media. The essential considerations for this evaluation therefore are cost comparisons between narrowband and wideband “outhouse” communication options. Another factor is the present lack of availability of two way wideband infrastructure to the average residential customer and the near term timescales over which the provision of services is required. The potential strategy options are therefore:

(1) Use narrowband “outhouse” media over the whole lifetime of the services, (>10 years).
(2) Use narrowband “outhouse” media until it becomes cost beneficial to migrate the services to wideband media as they become available.
(3) Delay the implementation of narrowband services until wideband media become available and cost effective.

In order to evaluate these options for the provision of the basket of services defined in Chapter 2, financial studies applied to a customer population have been carried out using the eaCOMMS model. The customer population comprised 3695 customers attached to an electricity network comprising 45 distribution substations. The area covered by the population Input data for the customer population, the penetration of services into that population, and definitions of costs of individual hardware items and annual charges are shown in Table 3.

Financial studies which included capital and capitalised annual charges, have been carried out for four, two level, communication hierarchies, external to the home, supplying the services to the population of 3695 customers. The hierarchies evaluated are:

(a) Radio/radio
(b) Telephone

(c) LV DLC/Radio
(d) Wideband (cable)
These four hierarchy options are shown in Figures 4, 5 6 and 7.

The narrowband communication hierarchy shown in Figure 4 comprises a completely radio based solution with local radio cells used to exchange data with approximately 1000 customers. A radio based wide area network is used to exchange information between the local cells and the centre. This infrastructure could be existing or constructed specifically for the provision of the services.

Figure 5 shows a PSTN based narrowband solution with switched network access provided to enable customer/utility or service provider data exchanges to be carried out. Call charges, line rental and the customer gateway are the cost items for this option.

Figure 6 illustrates a two level hierarchy using a different narrowband communication medium for each level. Power line communication using the low voltage distribution network is used between customers and distribution substations (DSS). The number of customers on each DSS in urban situations ranges from 50 to 300. A wide area radio network is used to exchange information between the distribution substations and the service provider. The communication architecture would need to be established either by the distribution utility or service provider in order to implement the services.

Table 3: Customer and Network Data for Media Evaluations

Figure 7 shows a wideband fibre/coax arrangement with the lower level concentrator accommodating approximately 1000 customers. Links between customers and the head end comprise a fibre backbone between the concentrator and head end and coaxial cable for the last link to the customer. This network would be already established for other purposes. Costs associated with using the network for narrowband services would be based on an annual charge per customer, plus the capital cost of a customer gateway.

The evaluation has been carried out by constructing a realistic network and geographic areas for the customer base so as to quantify radio and power line communication options. For radio and powerline options, communication networks have been constructed and costed. For telephone and wideband networks, customer equipment costs have been estimated as well as annual charges and call charges. Satellite and terrestrial broadcast media require a PSTN or radio return communication network in order to implement the agreed services. Both satellite and terrestrial media have advantages over PSTN for broadcast, customer/utility services. However it is difficult from a financial justification perspective to use both narrowband and broadband media for these services. It is likely that the narrowband media would be used. Consequently, satellite and terrestrial wideband infrastructure options are considered to be the same in cost terms as PSTN. Estimated costs for all the items have been obtained from discussions with relevant organisations in several countries. It is always extremely difficult to obtain projected costs for hypothetical systems so that the costs of the wideband option must be regarded as negotiable.

The results of the evaluation are presented in Table 4 illustrating the present value, cost over ten years and 10 per cent discount rate for all the options

Table 4: Results of media costing evaluation ($US) (3695 customer installations)

Media	Capital cost	Annual cost	Present value cost at 10% for 10 years	Cost per customer
Radio/Radio	427,000	30,000	611,200	165
Telephone	312,000	130,000	1,110,000	300
DLC/Radio	559,000	34,600	771,000	208
Wideband (cable)	415,000	176,000	1,500,000	404
wideband (cable)	415,000	88,000	955,000	258

6 Discussion of Results and Strategies

The financial evaluation results for using the communication architecture for the implementation of the services, Table 4, show that the three narrowband options are significantly cheaper in present value terms than the wideband option. This is with the annual price for the use of wideband media set at an average annual charge per customer of $48. If this charge is reduced to an average of $24/year/customer the present value of the wideband option reduces to be reasonably close to the present value cost of the narrowband options. This pricing position can provide a platform for negotiating the charge/customer for the use of wideband networks for these services. The incremental costs to wideband network providers should be small in order to implement the narrowband services, following completion of the network infrastructure. Consequently, prices are likely to be significantly determined by what the market will bear so that negotiations on price, based on alternative communication options should be successful.

The fact that the results of this costing evaluation show that the use of wideband media will not obviously result in costs lower than for the use of narrowband media, means that strategies which migrate from narrowband to wideband media over time and which involve the complete replacement of customer gateways are unlikely to be financially viable. Consequently unless there is a service which utilities or services suppliers wish to provide in addition to those already provided using narrowband media and which also requires a capacity in excess of that provided by the installed narrowband system, changing to a wideband "outhouse" medium will not produce financial benefits.

In order to understand the implications of these findings on strategies for implementing services to a customer population, a representation of an evolving market is required. From the development of wideband infrastructure in participating countries descriptions in Chapter 3, the penetration of wideband services into residential customer markets is progressing rapidly. It is anticipated that possibly 50% of the residential customer market will be equipped with a wideband gateway in 5 to 8 years. The remainder will not be equipped for several years into the future and some of them may never be equipped. Consequently there will be a mix of narrowband and wideband solutions which will need to co-exist, with the narrowband options able to be cost effectively upgraded. In order to address this market therefore, a range of gateway architectures is required. It is unlikely that wideband services providers will invest in infrastructure to implement the defined narrowband services until a reasonably large market exists, perhaps 50%. This is because, even at that level of market possibility, the market will be shared among many wideband service providers and media.

The consequences of this market not being sufficiently large for 5 to 8 years is that, if the provision of utility services is required before then, narrowband solutions are the only serious option. As has already been discussed, these narrowband solutions must include the possibility of accepting wideband media input in the future. The long term market for customer gateways should therefore comprise flexible arrangements to deal with:

(a) narrowband external media input with no migration to wideband media
(b) narrowband external media input with potential to migrate to wideband media
(c) wideband media input only

In the long term, services will be provided by wideband external media linked to separate narrow and wideband "in-house" busses through a common gateway. A summary of services, media and gateway structures is shown in Table 5.

Strengths and Weaknesses of Wideband Strategies

This financial and previous technical evaluations show that there are no technical reasons why customer/utility services cannot be provided in a 5 to 8 year time horizon using wideband media at a competitive price. However within the range of prices determined for wideband and narrowband media provision of the services, it is unlikely that sufficient financial benefit will exist to justify migrating from a narrowband installed solution to a wideband solution. This deduction is very speculative as it assumes a constant set of services able to be supplied by narrowband media. It also assumes that there will not be a significant reduction in the annual charges quoted for the use of wideband media for narrowband services.

It is easy in situations like this where potential benefits of delaying making investments look likely in the future. This situation is always present when considering investments in electronic services such as PCs. If followed, it will negate many profitable investments. The important investment issue of whether to invest in narrowband or wideband communications, is whether either of them are cost effective and available. At the present time, evaluations of services provision using narrowband media have shown them to be viable if many services are included. Wideband media are not yet available to the majority of customers in a bi-directional form. Consequently if services provision is required now or within the next five years, then the only option is a narrowband solution. When wideband solutions become available at cost effective prices (linked with other wideband packages of services), then they will be installed instead of narrowband solutions. Whether the installed base of narrowband equipments will be replaced by wideband units will depend upon the costs and desire by customers for possible additional services. This could be, for example, high speed Internet access, banking, shopping and video provided by another, non utility organisation but used to assist cost justification of the change. Tie-in that situation.

The projected financial benefits of using wideband media when they become available, are not sufficient to justify delaying the provision of cost effective customer/utility services using narrowband media.

Strategy Solutions

(1) If customer/utility services using communication can be provided now in a cost effective manner, then that should be carried out using narrowband media.

(2) Installation of those services should be via a flexible customer gateway so as to facilitate media and protocol changes, including migration to wideband.

(3) Use wideband media, at a negotiated lower price, for the provision of narrowband services when it becomes available to the average residential customer (> 5 years).

(4) Migrate services installed using narrowband media to wideband together with possible other services when it becomes cost effective, particularly if the narrowband services provision is via a flexible gateway.

Table 5: Communications and Gateway
Options for Customer Services defined in Table 1

Outhouse media	ST7 Services > 600 baud	ST7 Services + Internet >4800 baud	ST7 Services + Fast Internet, TV etc > 128K baud
Narrowband radio (1200 baud)	ST7 Gateway	Not viable	Not viable
LV Slow PLC 600 - 1200 baud	ST7 Gateway	Not viable	Not viable
Standard Phone 1200 baud	ST7 Gateway	Not viable	Not viable
Pager (two way) 1200 baud	ST7 Gateway	Not viable	Not viable
Phone >64K baud	Phone modem and ST7 Gateway	Phone modem and ST7 Gateway	Not viable
Broadband radio >64K baud	Radio modem and ST7 Gateway	Radio modem and ST7 Gateway	Not viable
High speed LV PLC (1M baud)	PLC modem + ST7 Gateway	PLC modem + ST7 Gateway	Not viable
Satellite (two way) (10M baud)	Set Top Box ST7 Gateway	Set Top Box ST7 Gateway	Set Top Box ST7 Gateway
Fibre coax (Two way) (10M baud)	Cable modem + ST7 Gateway	Cable modem + ST7 Gateway	Cable modem + ST7 Gateway
Phone XDSL (10M baud)	XDSL modem + ST7 Gateway	XDSL modem + ST7 Gateway	XDSL modem + ST7 Gateway

7 Conclusions

Technology and market for wideband communication are moving very fast, particularly for business, and offer income bracket customers. Attempting to tie down parameters sufficiently rigorously in order to make decisions is therefore difficult. The pace of growth of the wideband market appears to be similar in all participating countries. Previous investigations into the financial viability of individual services for utilities involving customer communications have generally produced negative results. Offering collections of related services is a more viable proposition, particularly when wideband services can be included. However bi-directional wideband communication is not available to the majority of residential customers either because the infrastructure has not yet been developed or the costs are prohibitive.

This study has shown that there are no technical reasons why the agreed set of customer/utility services cannot be provided by wideband media. Because satellite and terrestrial broadcasts require a separate communication medium in order to be bi-directional, it is concluded that the return medium is likely to be the one to be used for these narrowband services. Consequently only the use of fibre/coax cable as a wideband medium has been financially evaluated. The price for using wideband cable systems for the provision of the services is shown to be twice as expensive as the narrowband options based on annual charges estimated by cable operators. However these charges are negotiable and should only be regarded as initial estimates.

The study concludes that, based on the costing information available and the installation of a gateway which can be upgraded to operate with wideband customer equipment, narrowband systems should be installed. This pre-supposes that the collection of agreed services can be provided cost effectively using narrowband media. Over the next 5 years it is expected that the services could be provided more cost effectively using wideband media, but that is by no means certain. In this situation, both narrowband and wideband solutions would co-exist. Where financial benefits could be obtained or augmentation of services was required, migration of the customers supplied with narrowband media to wideband media could take place. This would be readily possible if a flexible narrowband gateway had been used and provision made for possible upgrading.

8 Recommendations

- Further, detailed discussions - should be carried out with wideband network operators to try to negotiate lower access prices.
- Further detailed discussions should be carried out with Set Top Box/Cable modem manufacturers to ensure that interfacing with narrowband customer networks is included.
- Ensure that the customer gateway architecture, determined in Sub Task 7 and proposed for realisation in Sub Task 9, is compatible with a Set Top Box/Cable Modem interface.
- Carry out a field trial of customer energy services using wideband infrastructure external to the home.

9 References

[1] eaCOMMS model: “Design for Function and Communication Evaluation and Costing Model”, IEA, DSM, Annex II, Report, October 1996.

[2] “Definition and Specification of Residential Customer Gateway for DSM and Related Services”, IEA, DSM, Annex II, Report, September 1998.

[3] Euro Cable Directory, October 1998.

Figure 1: Gateway Functional Architecture

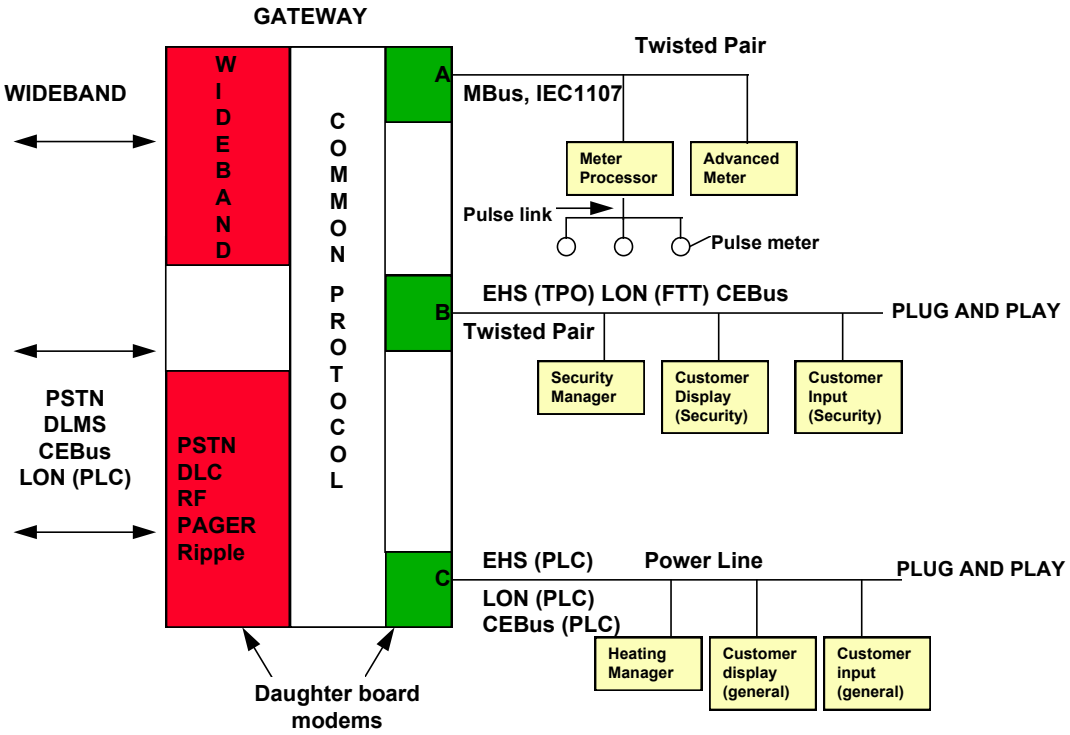

Figure 2: Customer Wideband Media Architecture

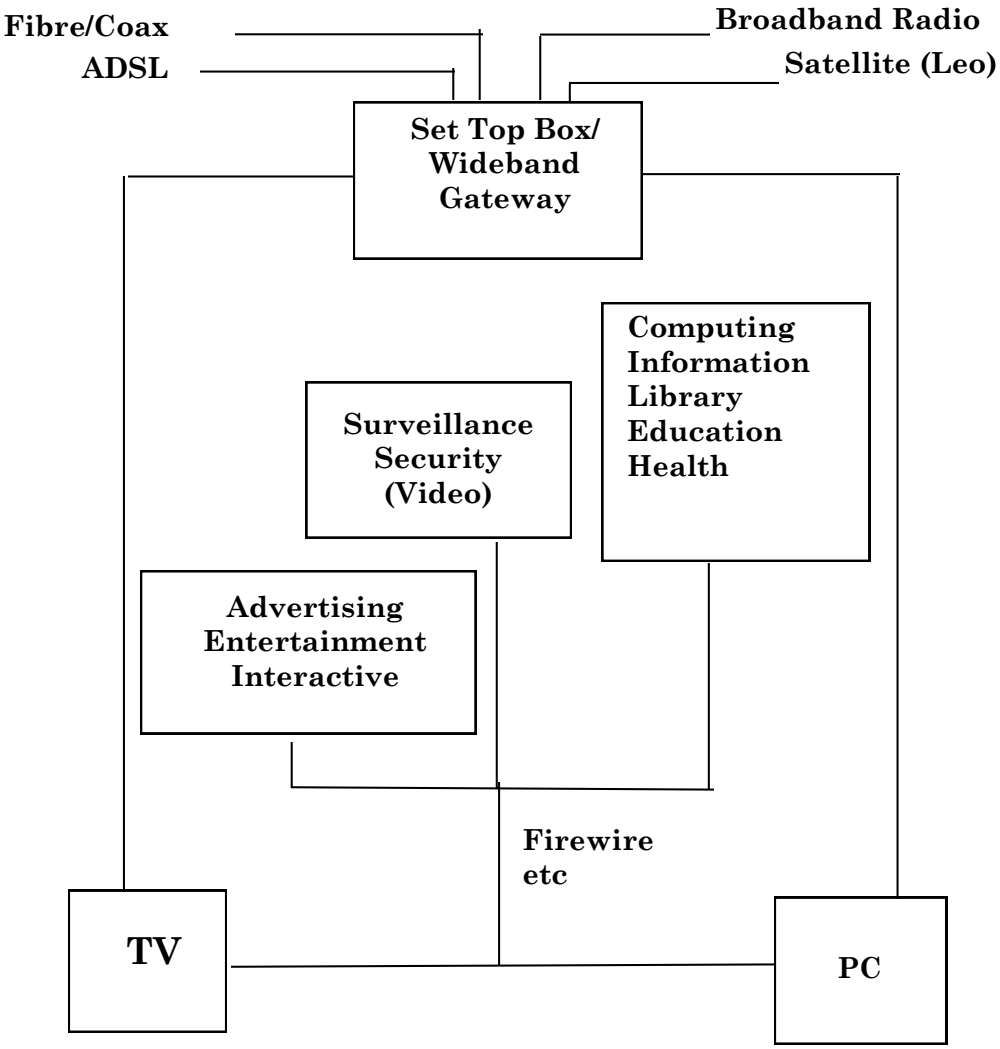

Figure 3: Customer Narrow & Wideband Media Architecture

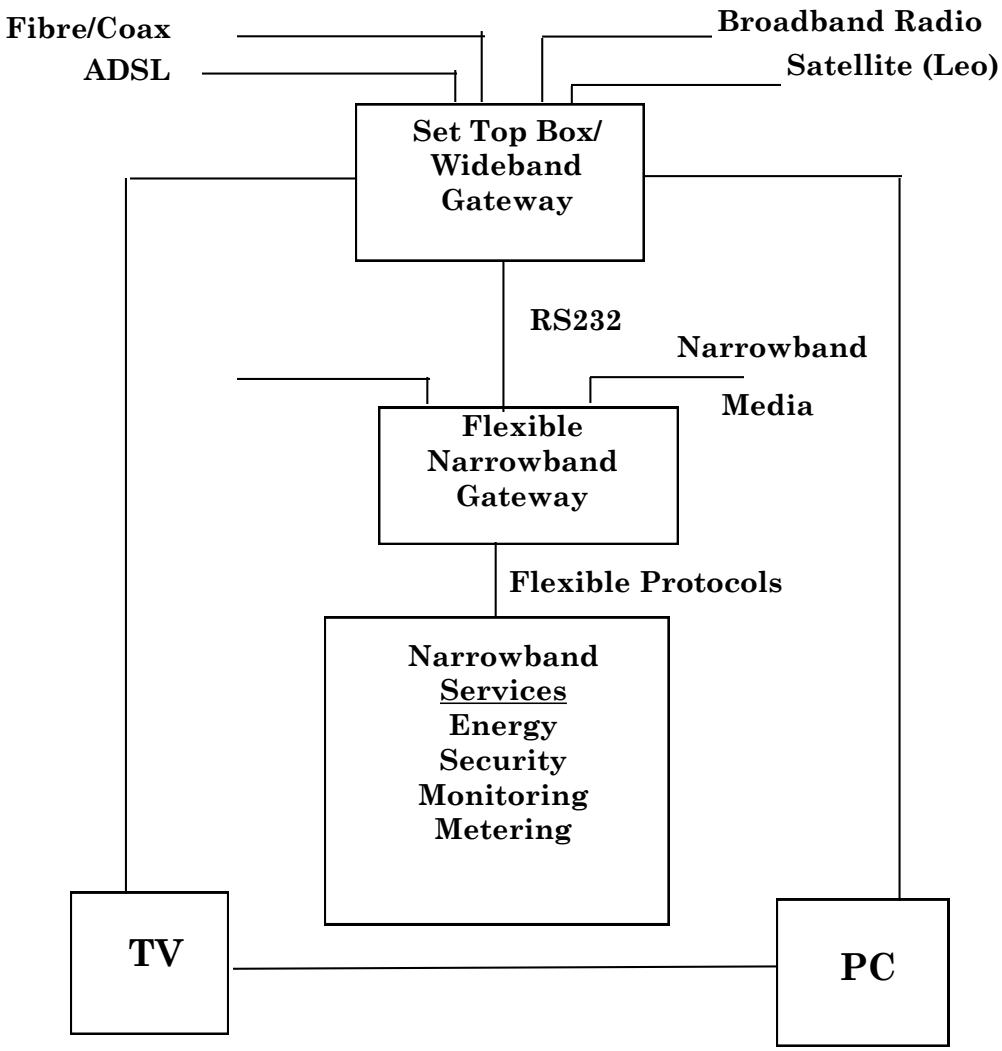

Figure 4: Radio/Radio

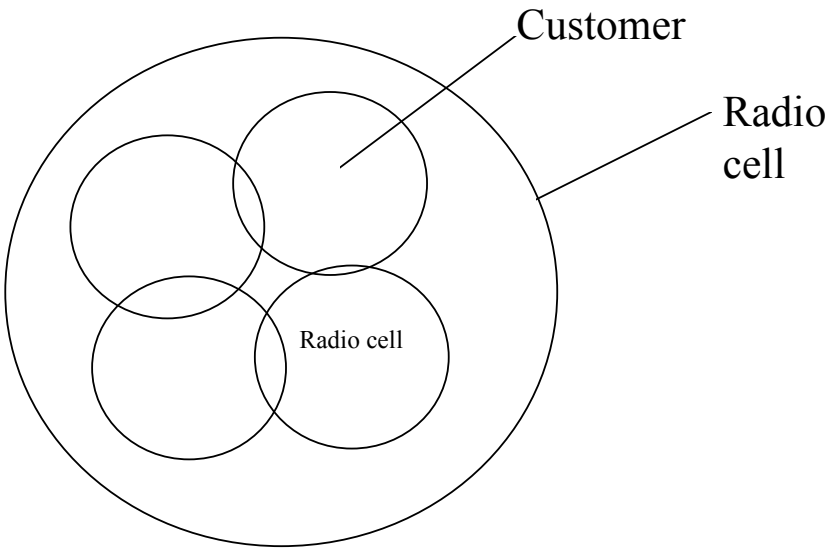

Figure 5: Telephone

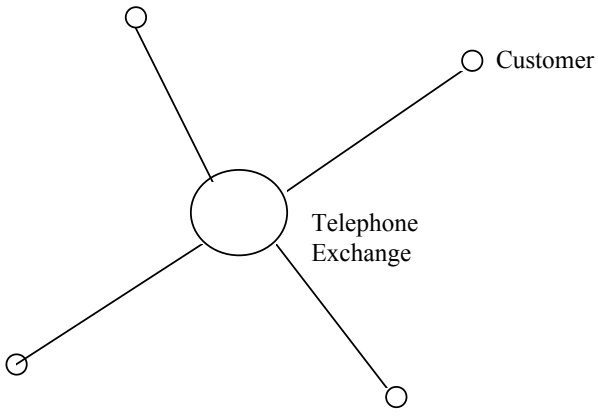

Figure 6: LV DLC/Radio

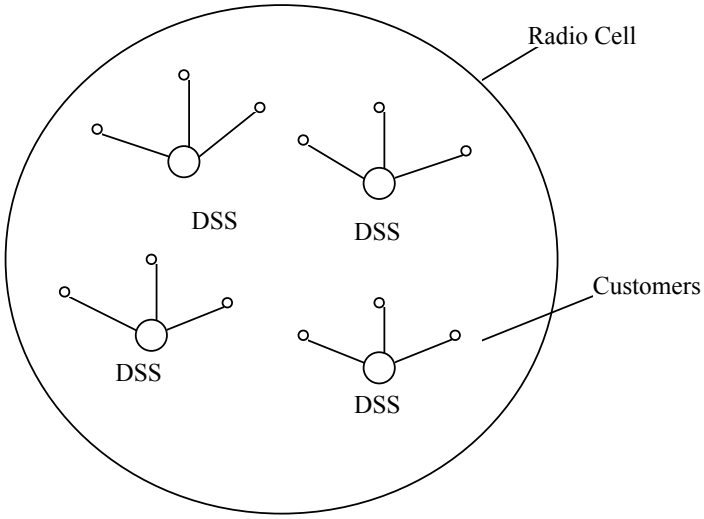

Figure 7: Wideband Fibre/Coax