1Technical Challenges and Opportunities

Interim Document for "Community Television – a scoping Study"

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1.1Reception and Transmission Technology

Choosing the right technology for a community television project is important. The solution needs to be

- Simple to deploy and maintain
- Cost effective
- (why low power – if you could give me high power for low cost I would take it) If power consumption is too high then it may be difficult to secure sufficient power in a rural location?)
- Reliable

The technology chosen will depend on what existing TV broadcast networks are already operating in the region, compatibility is often the overriding technical consideration for a new broadcast channel if you want to reach the mass population. If inappropriate technology is installed then this will hamper the roll-out of the system. It will also discourage those setting the station up. Broadcasting and communications technologies are converging with computer technologies. This is providing radically different ways to transmit programming, we look at the opportunities presented by using computer networks as a way of transmitting programming.

Donors are often keen to donate second-hand equipment to support such projects however it is vital for the success of project that any equipment accepted is suitable. Refer to the four points listed above and ensure that the donated equipment meets this criteria.

1.1.1Terrestrial Analogue TV

An existing mature technology, TV receivers are widely available and are comparatively cheap as they are made in high volumes. Transmission equipment tends to be high power and priced at professional levels, some second hand equipment might be available. UHF and VHF frequencies are used with 3 main standards in use, PAL, NTSC and SECAM. The system used will depend on the dominant standard in use in the region the station is to be established.

Cost of Local Solution

A simple 2W UHF transmitter system can be built for less than $2500 US Dollars, this will give a range of up to 6Km in an open area. [i]

Availability

The rest of the world is moving over to all digital systems for television transmission. In the UK Analogue television is expected to be turned off in 2012. Deploying analogue television into communities where currently television is unavailable may cause problems as the support for analogue networks may be difficult in a few years time.

Frequencies are regulated and often are not available for community stations. Where thy are available the cost of a broadcasting licence generally does not make it viable for a small community station to operate.

The greatest advantage of using terrestrial analogue television is as an established technology receivers are low cost and if some television programming is already available locally then there will be an audience already equipped with receiving equipment and able to view a community station.

1.1.2Adding Teletext to Analogue TV

Teletext text allows simple text based information to be transmitted along side analogue TV signals.

Cost of Local Solution

Systems aimed at large commercial broadcasters use standalone units to create the text and to multiplex the data on to the video signal. A small system based around a PC can be purchased for about €2200 These devices will normally use Roman script if the local language group uses a non roman script then it might be difficult to find a teletext package to support this.[ii]

Using the editing software pages can be created with local content this allow information to be shared in the local language, teletext information can be retrieved by the viewers at a time to suite them. Teletext can also be used to present additional; information after the screening of a program to reinforce the message and also to provide additional information.

Availability

Teletext information is a useful addition as the information can be retrieved at a time to suite the viewer. To receive teletext viewers will need to have more up to date and consequently more expensive television sets to benefit from the addition of teletext information to the service.

1.1.3Terrestrial Digital TV

Terrestrial TV allows the number of transmitted channels in a given band allocation to be increased. Digital television can increase the quality of the picture and sound in good signal areas. This is achieved by using digital encoding schemes with high compression rates. Sophisticated algorithms allow adaptive codding rates to be used. For example a studio based news broadcast with a static unchanging backdrop can be transmitted at a lower data rate as only the changes in the presenters body need to be updated, a football match or action film with a fast changing image will need to be transmitted at a higher rate. A network can manage this and optimise capacity in a given spectrum allocation.

Current terrestrial digital television in the UK operates in the UHF television band between 470 and 854 Mhz. There are two transmission modes used in the UK, 16 QAM and 64 QAM. It is only possible to broadcast 4 to 5 TV channels on a multiplex operating at 16 QAM, whereas one operating at 64 QAM could broadcast between 6 and 8. However, coverage from a 64 QAM multiplex will be less than that of a 16 QAM multiplex, and the signal will not be as robust. Currently Multiplex 1, B, C and D use 16 QAM, and multiplex 2 and A use 64 QAM. There is a trade-off between coverage/robustness of signals, and capacity.[iii]

Cost of Local Solution

Equipment required to set up a digital broadcast station is expensive. A Digital Modulator and a Digital television transmitter will be required, this will cost in the region of €20K for a transmitter with a 10 W output operating in the 470 - 860 MHz ban[iv] A digital television system can use lower power transmitters to provide the same level of coverage, the coverage provided by a transmitter is determined by the local terrain. I have not found a reference giving a indicative range.

The signals can be received on an existing analogue television with the addition of a set-top box that in the UK is retailing for about £50. It can be difficult to add a digital decoder to an older television that is not equipped with SCART sockets.

Availability

Currently this is not very practical for a local television system, The key advantage of digital transmission for television is the ability to transmit multiple television channels on a single UHF channel, this is only required in an urban area where capacity is an issue. If digital television is operating in a locality then it might be possible to add the loacal television channel to an exiting multiplex.

1.1.4Satellite TV

Satellite TV is well established and has the benefit of providing high quality coverage over a wide area.

Cost of Local Solution

Air time will need to be rented on a satellite to enable the programming to be transmitted. A ground line will need to be leased to the uplink earth station. In addition the reception equipment can be quite expensive. Most satellite channels apart from government funded public service broadcasts and some advertiser funded channels are scrabbled requiring those people who wish to view the programming to by a subscription.

Availability

Satellite technology is well established, the trend is towards Digital transmission and some older equipment will become obsolete soon. It would be suitable for a community TV station if the community being served was not a confined to a small geographic area. Perhaps a nomadic community spread over a wide area might be best served by this. The receiving equipment also needs to be considered, satellite dishes need to be aligned in the correct direction to allow signals to be received. An advantage of using a satellite system is the availability of multi channel programming attracting the community to make the investment in the receiving equipment.

1.1.5Cable TV

If cable TV exists in an area then adding a community channel on to the existing services is likely to be a cost effective solution, it will also have the advantage that the viewers will not require any additional equipment to allow them to view the new content.

Cost of Local Solution

If a local cable system is available then the costs of adding a channel are low. Cable TV is a subscription service so is unlikely to serve the poor in the community.

Availability

Established technology available in urban areas, A set-top decoder and a subscription is required to view programming.

1.1.6Terrestrial Licence Free TV using video senders

Frequencies between 2400 Mhz and 2483.5Mhz are available for use without the need for a licence in most parts of the world. Services such as Wlan and Bluetooth currently use this band, wireless broadband services are being designed that will also use this frequency band

Getting access to broadcast spectrum is difficult in many countries, the spectrum has often already been allocated to commercial and public broadcasters and there is no allocation available for community stations.

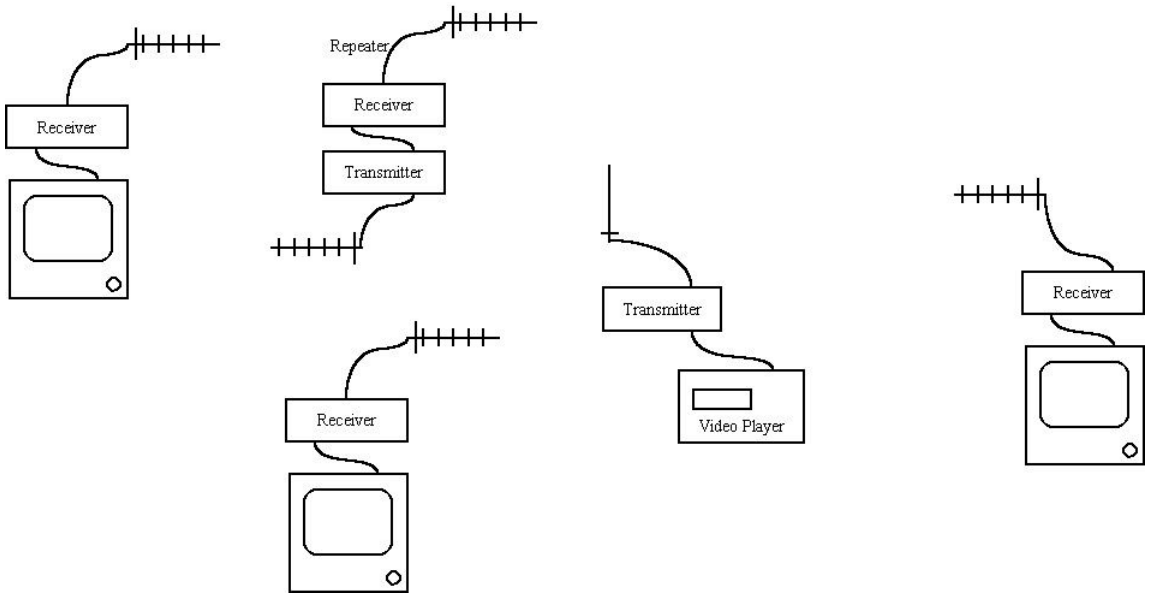
By international agreement there are a number of bands available for use without a licence. This includes a band at 2.4 GHz (Frequencies between 2.4GHz and 2.4835 GHz) and 2 bands at 5GHz (Frequencies ranges 5.15 to 5.35 GHz and 5.47 to 5.725GHz). The 5.15 to 5.35 GHz Band is restricted to indoor use at least in the UK. Using these frequencies it possible to set up a station without a regulated frequency.[v]

Analogue Systems

Using consumer products originally designed to allow home owners the ability to transmit cable and satellite television programs from the main receiver to secondary televisions around the house a broadcast network can be constructed quickly and for a low cost.

This system has been used by the UK based Institute of Local Television in a number of field trials around the UK. The system uses video senders to broadcast television on the 2.4 GHz band.

These units operate in the 2.4GHz band and do not require a licence, the user can select a can select one of 4 frequencies (2.414, 2.432, 2.450, & 2.468 GHz) on which to operate. Using directional antennas ranges of up to 5KM can be achieved with an ERP of 10mW.[vi] These units use analogue FM modulation for transmission.



Typical 2.4GHz system using repeaters to extend range.

A 2.4GHz receiver needs to be installed on each television that wishes to receive this station. There is no limit to the number of televisions that can simultaneously view the signal. A 2.4GHz sender is used to transmit the programming, this will usually be located at a high location giving good unobstructed line of site paths to as many locations within the desired coverage area. For locations on the fringe of the coverage area directional antennas aligned to the transmitter will be required. To increase the coverage repeaters will be required at strategic locations.

Cost of Local Solution

These devices are available in the UK retail for around £30, if we source these locally we would expect reduce this price to about £10. These devices will connect to a television but a SCART connection is usually required so many older televisions will not be compatible with the set top boxes.

Availability

Useful if a community already has television sets, this technology allows a local station to be setup quite cheaply without requiring a licence. This type of system is prone to interference from other users of the spectrum including Bluetooth devices and alarm systems. Ghosting from signals and the effects of stray signals from privately owned video senders used within homes could degrade the signal. Of particular concern is the growth of 2.4GHz WiFi networks. WiFi uses a spread spectrum modulation technique and this has the potential to cause interference on all 4 channels available to 2.4GHz video senders.

Digital systems.

The Digital Television Group in the UK has commissioned a study[vii] looking at using the licence free 5GHz Spectrum to allow the deployment of Video Senders using digital encoding, the standards will be based on the DVB-T specifications allowing higher quality relaying of signals around the home. I am not aware of any devices yet available conforming to this specification in the UK.

Once devices become available that allow multiple receivers to be connected to a single transmitter these devices could be used in the same way as 2.4GHz analogue video senders are used today. This system would be as flexible as using a networked solution but might be simpler to operate and set up for the end users.

Cost of Local Solution

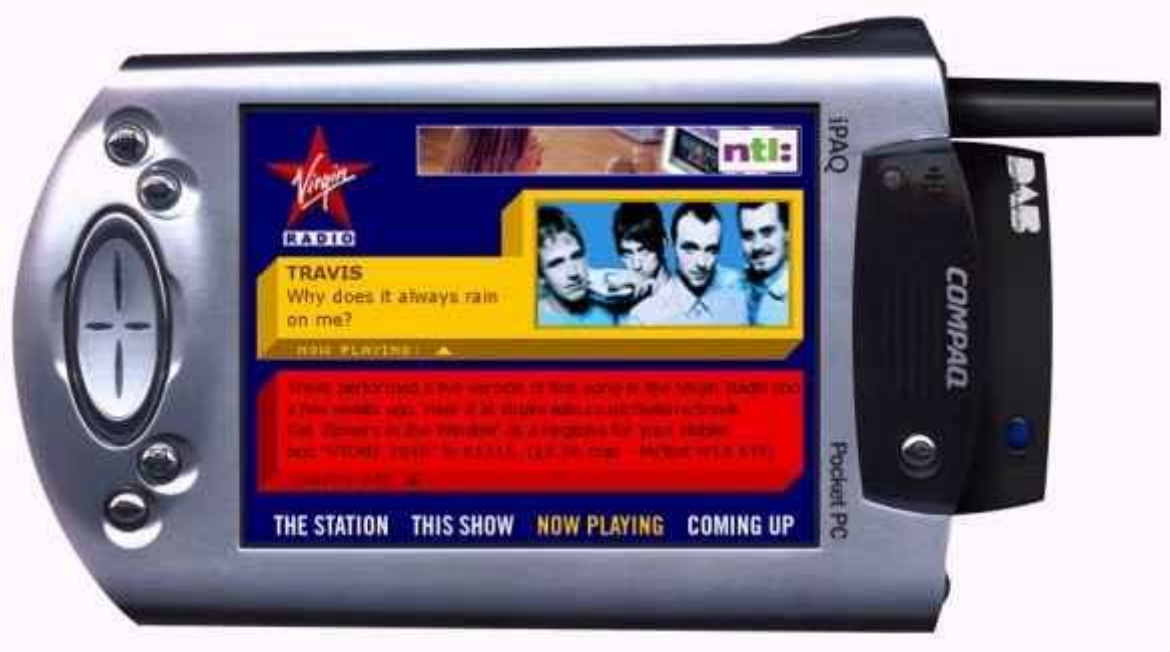
The Belkin Pure AV remote TV is available in the US and retails at $500.[viii] This is a digital video sender operating in the 5 GHz band. Currently it is only possible to add multiple receivers to allow the signal to be relayed to multiple remote screens. Currently the cost of digital video senders is too high to be considered for a community television station. The costs will fall assuming that these devices are successful and find a mass market in the western world.

Availability

Currently I am not aware of any digital video senders that allow signals to be sent to multiple televisions simultaneously.

1.1.7Digital Radio

Digital Radio (DAB) uses 2 bands Band 3 173 to 239MHz and Band L 1.45 to 1.40GHz. Band 3 is currently used in the UK. Digital radio offers the opportunity to send text and images along with the audio, a kind of halfway house between TV and Radio. Today's receivers typically have a LCD display that can scroll text information. Typically information on the music being played, news or sports results are displayed along with station identification information. This can be enhanced and below is an view (from www.radio-now.co.uk) of what a future DAB receiver might look like with an enhanced display.[ix]



This type of service could be supported by LAN and also by 3rd generation mobile phone systems. If deployed on LAN or 3rd generation phone systems then the service could be fully interactive.

Cost of Local Solution

Digital radio receivers have reduced in price from around £100 to £50 in the UK over the last 12 months. Prices will continue to drop and the price differential between FM/AM and digital receivers will be eroded.

Availability

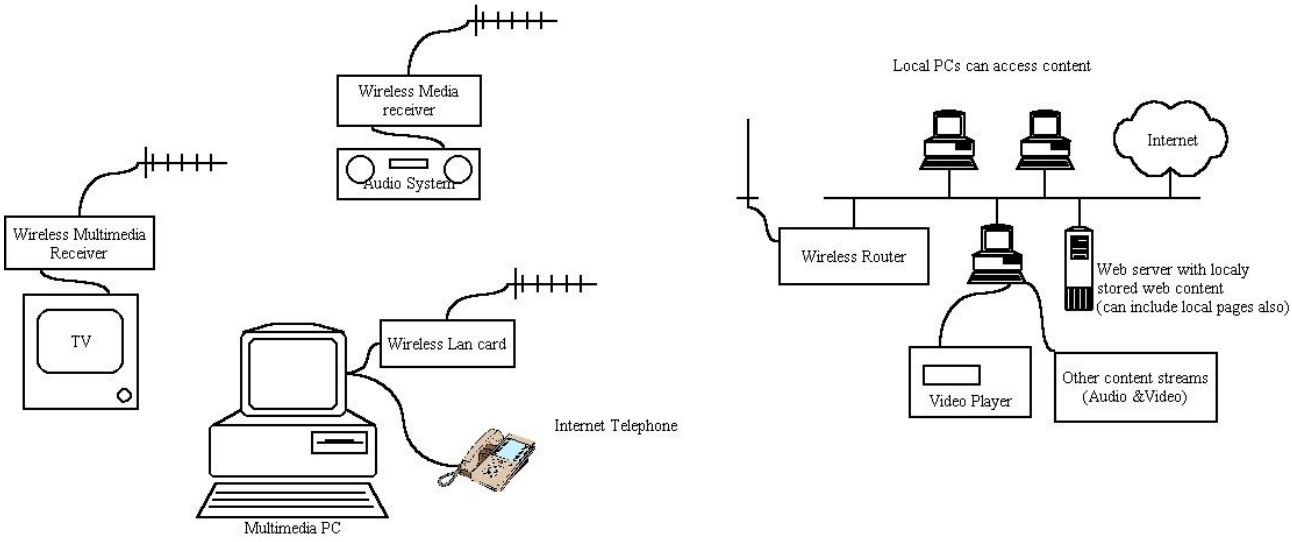
Current sets offer limited text information alongside the radio, devices such as the one illustrated above are still in the concept stage. Current digital radio offers only limited benefits for a community radio project but a multi media broadcast service such as illustrated by the concept device above could provide an interesting intermediate service that is not quite television but not a traditional radio service.

*1.1.8**Networked Systems***

Standards have been developed to allow the wireless networking of computers using unlicensed frequencies in both the 2.4GHz and 5GHz bands. WiFi devices are defined by the IEEE 802.11 series of standards and use 2.4GHz spectrum. Typically WiFi is used to set up small office and home networks allowing the sharing of a common broadband

internet connection and file sharing between computers. WiFi (802.11) is designed to offer service over a small local area typically up to a maximum of 100M radius. A new standard WiMax (802.16) is emerging that will be designed to offer wireless broadband service with cell radius of up to 5 Km. It should be noted that appropriate antennas the range of a system using WiFi system technology can be greatly extended. Ranges of up to 1 mile can be achieved with good quality antennas, using a parabolic reflector has increased line of site ranges to over 10 miles.

We are interested to see how this technology could be used to distribute television programs and other information services.



Typical multimedia broadcasting system using WiFi or WiMax

WiFi and WiMax are typically used to network computers and allow the exchanging of files, sharing peripherals and also sharing a common broadband connection. With the integration of computers with home entertainment centres we see possibilities to broadcast video and audio programming over a Local Area Network (LAN).

Trials are being undertaken by British Telecom to distribute video on demand through Broadband using Freeview digital TV technology with an interface allowing direct connection to the broadband network[x]. A system developed by Video Networks amd marketed under the brand Home Choice (www.homechoice.co.uk) is already delivering packages offering television, video on demand, telephone and broadband internet over an ADSL line. The service is currently available in London and Stevenage.

It is not clear what bandwidth is required to deliver this service. Using MPEG4 encoding at least 1Mbps of bandwidth is required for acceptable quality and most broadband connections are currently 512Kbps. Also a broadband connection is not available at its highest rate all the time as other users on the system affect the available bandwidth. On a domestic broadband connection the contention rate is typically 50:1 with 20:1 being offered on a business package. With a 50:1 contention ratio if all users were downloading information simultaneously then the data rate would be reduced to 10.24Kbps per user. This is however unlikely to happen with normal Internet usage but is a very real problem if many users are accessing streaming web content such as audio and video material.

Using Wireless LAN technology to set up a community broadcasting system offers us opportunities to offer IP telephone, email and other services over that same network. It is a system that can grow as the users get more familiar with the technology and the service offered to each user can be tailored to their needs.

Point to Point Broadcast

IP wireless networks devices are becoming available to allow audio and video to be shared from a PC with the home HiFi or Television. These devices are available operating in both the 2.4 GHz and 5GHz bands. These devices allow you to listen to music or watch video on your entertainment systems. Example of this type of product is the D-Link 802.11g Wireless Media Player (DSM – 320)[xi].

These devices use the LAN to distribute Audio and Video using TCP/IP. This is suitable for point to point communications between the computer and a home entertainment system. The user has access to stored audio , video and still images stored on his computer, he can allow access material on the internet if he has a internet connection available.

We are interested in sending video to many users. Whilst this can be achieved by setting up a individual point to point connection with each user using a point to point TCP/IP connection this is not going to be practical for the type of network we envisage. Streaming broadcast quality video requires a high data rate connection so we would need an very high bandwidth network if we were to set-up our system this way.

Multicast Broadcast

An alternative is to send material as a multicast using UDP/IP. Using UDP the information can be received by all internet clients listening to the IP address defined for this multicast, this can be regarded in a similar way to tuning in to a conventional broadcast. This technique is commonly used on company intranets where many users are viewing a common video conference call. The disadvantage with multicast is that the broadcaster defines when the video is transmitted much like conventional television, with the point to point TCP/IP approach a video on demand service can be offered.

In addition to the high quality video programming sent in UDP Multicast mode to be watched in real time the user also may have access to stored audio and low quality video clips at other times. It may also be possible to send a audio program perhaps with low bandwidth graphics such as text pages and still images at the same time. The number of channels that can be sent will be limited by the network capacity.

One area that needs further investigation is to confirm the current multimedia players are capable of viewing a multicast (UDP) stream.

To set up a server capable of transmitting the program requires a computer that will accept video inputs.. The open source software program VideoLAN makes it easy to put Multicast streams on to a network.

Research carried out at the University Collage London[xii] looked at the possibilities of using WiFi (802.11) standards to multicast a single Mpeg2 encoded digital TV stream. Measurement were taken of UK Digital television and the bit rates varied between 2.9 Mbps and 4.7 Mbps. A test system was then set up using UDP multicast over a network.

Due to basic rate limits specified in the 802.11 standards document in 802.11g mode the measured multicast throughput was 1Mbps, whereas 802.11a provided 5.1Mbps, only 802.11a is suitably for carrying digital TV. The project looked at the impact TCP traffic in the same network has on the performance of the UDP data stream. If the network has high levels of TCP/IP traffic present this can lead to an unacceptable error rate on the UDP data stream. The work at UCL looks at possible improvements the protocols to minimise the effect of TCP traffic on the UDP traffic.

IP-TV

Microsoft are developing software to allow television programs to be delivered over the Internet. The International Herald Tribune on the 18th November 2004 reported a $400 million deal between Microsoft and the broadcaster SBC Communications to use the software to deliver TV over its high speed data line. This software is aimed at the broadcaster and the broadband network operator.

By its nature IP-TV will offer the opportunity to change television from a one way broadcast medium to an interactive 2 way process where viewers can interact and respond back to the broadcasters in a real time on-line manner. This offers exciting prospects for engaging the community in debates and helping them to take ownership of the development process. This is a set of standards and proprietary software that will allow television programming to be delivered on an IP network.

Cost of Local Solution

The components required to build such a community network are standard computer commodity parts and are available from many vendors and prices are falling fast for such components. Wireless multimedia receivers are still relatively new and have higher prices at the moment.

Availability

The technology will be new to many communities, it is more complex to install and maintain than some of the other technologies discussed. With a networked solution many additional services can be integrated in the future as new demands are identified. Setting up a broadcasting system using computer network technology will help bridge the digital divide in a community, local people can experience first hand this technology.

Forward and Store Technologies

Forward and store systems are used where the bandwidth available is not sufficient to support real time access. A data stream can be sent to a computer at a low data rate, stored and viewed once the download has completed. This program could be rebroadcast on a local television network to local receivers.

There are a number of examples of this type of idea being used. HF radio provides very limited bandwidth (3KHz is typical) and it is also a very noisy, error prone medium. Despite its limitations it is used by yachtsmen to access email services. Using a specially designed modem data rates of up to 2.8KBits can be achieved, this allows simple text emails to be exchanged. This shows how very low data rates can still be used to achieve successful communications, this data rate will not support video or Internet browsing even a store and use latter approach will be too slow.

In Ghana a system allowing rural areas with poor telephone infrastructure access to

selected Internet content. The system uses a downlink only satellite link to receive a selected block of Internet pages overnight, these pages are then made available on a local Internet server to local clients. This is cost effective as a uplink connection is not required. If the users want additional content they can request this using their GSM mobile Phones and the content is added to the package downloaded in the next transmission session.

This type of system could be very useful where the bandwidth to support continuous video streaming does not exist. A set of programming could be downloaded and viewed once the download is completed. This type of service may be useful in a health and educational establishment. This distribution mechanism could replace video or DVD distribution and allow the content to be updated more quickly and ensure that news and other information is current.

Once a program has been received it can be played in the same way as a video or dvd. The user can pause, rewind and advance the programming and watch it a time convenient to them. It is also possible for them to order specific content to be downloaded latter. We will see this type of delivery becoming available in the west over the next few years.

We can see how useful this type of service might be to send content to health centres, schools and collages to send content over night and store these programs locally on a computer or a hard disk recorder for latter viewing.

1.1.9Mobile Phone Technologies

Communications technology continues to develop fast and as this work progresses it will be essential to monitor future trends and ensure that the right technical solutions are being developed. In August the BBC reported on an ambitious project under way to find a way to send TV broadcast signals to mobiles by 2010. Dubbed Instinct, (IP-based Networks, Services and Terminals for Converging Systems)[xiii], the project is being led by West London's Brunel University. They aim to deliver high quality video to mobile phones at an affordable cost. Linked with cameras on the phones we can begin to see the possibilities for truly distributed community television.

1.1.10Summary

Using video senders (analogue or digital when it becomes available) offers the simplest set-up, remote units are simply plugged in to the viewers existing television set. One caution, many new AV devices only have the capability to connect via SCART or direct video connections, a UHF modulator is often not included on products so connecting to old televisions without a SCART socket can be difficult.

Using a LAN created with WiFi or WiMax technology offers interesting possibilities to offer additional services it also can grow with the users requirements. A broadcast network can be set up to individuals equipped with a multi media receiver connected to audio visual equipment (a TV or a monitor and speakers). The broadcasts could also be received by people equipped with computers, additional services such as email and Internet access could also be offered to these computers, the effect of this traffic on the would have to be monitored. It could be possible that during the day the network is used for Internet and email traffic along with audio broadcast and in the evening Internet access was removed

to allow the broadcast to be presented. Further system modelling needs to be conducted to establish the maximum size for such a network.

i http://www.rf-links.com/tv_broadcast.htm#1
ii http://www.cebra.dk/inserter/pci.htm
iii http://www.interactivetvweb.org/tutorial/dtv-intro/dtv-intro.shtml
iv http://www.itelcast.com/itelcast/php/tvlistino.htm#DIGITALTELEVISIONMODULATORS
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vi http://www.netgear.com/products/details/ANT24D18.php
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vii A Review of in -home networks Peter Marshall
http://www.dtg.org.uk/publications/books/home_distribution_v1-1.pdf
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ix http://www.radio-now.co.uk/news203.htm
x http://www.cdfreaks.com/news2.php?ID=10529
xi ftp://ftp10.dlink.com/pdfs/products/DSM-320/DSM-320_ds.pdf
xii A Resilient Multicast Protocol for Digital TV Over 802.11 Wireless Networks Richard Akester University College London. (WSEAS Transactions on Information Science and Aplications Issue 3 Vol 1 2004 Pg 908. (http://www.cs.ucl.ac.uk/staff/R.Akester/icomiv3.pdf)
Delivering Multicast Video Over Asymmetric Digital Subscriber Line (CISCO)
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Further References

(these are taken straight from Katherin's work, I have some additional references. I need to go through the report and use these references to support the chapters and debate, much as I have above.)

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Appendix