



Facts about DVB-T



DVB comments on the DVB-T
Digital Terrestrial Broadcasting Standard

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1. INTRODUCTION

Decisions on which Digital TV system to adopt are being taken across the world. Such decisions will have consequences lasting long into the future, and should not be taken without full awareness of all the facts.

Factual and accurate descriptions of DVB technology will assist government regulators and broadcasters in making the right decision for their markets. Arguments have been made which distort the facts and create dangerous misunderstandings of the key issues of Digital Terrestrial Broadcasting and particularly of the capability of the DVB-T standard. This document is intended to correct such misunderstandings.

One of the key areas where facts are misrepresented is in claims about adoption of digital television systems world-wide. The map below presents a summary of the world adoption picture for satellite, cable and terrestrial systems, as it was at the beginning of December, 1998. As can be seen, virtually all countries of the world use one or more members of the DVB Digital TV standards family.

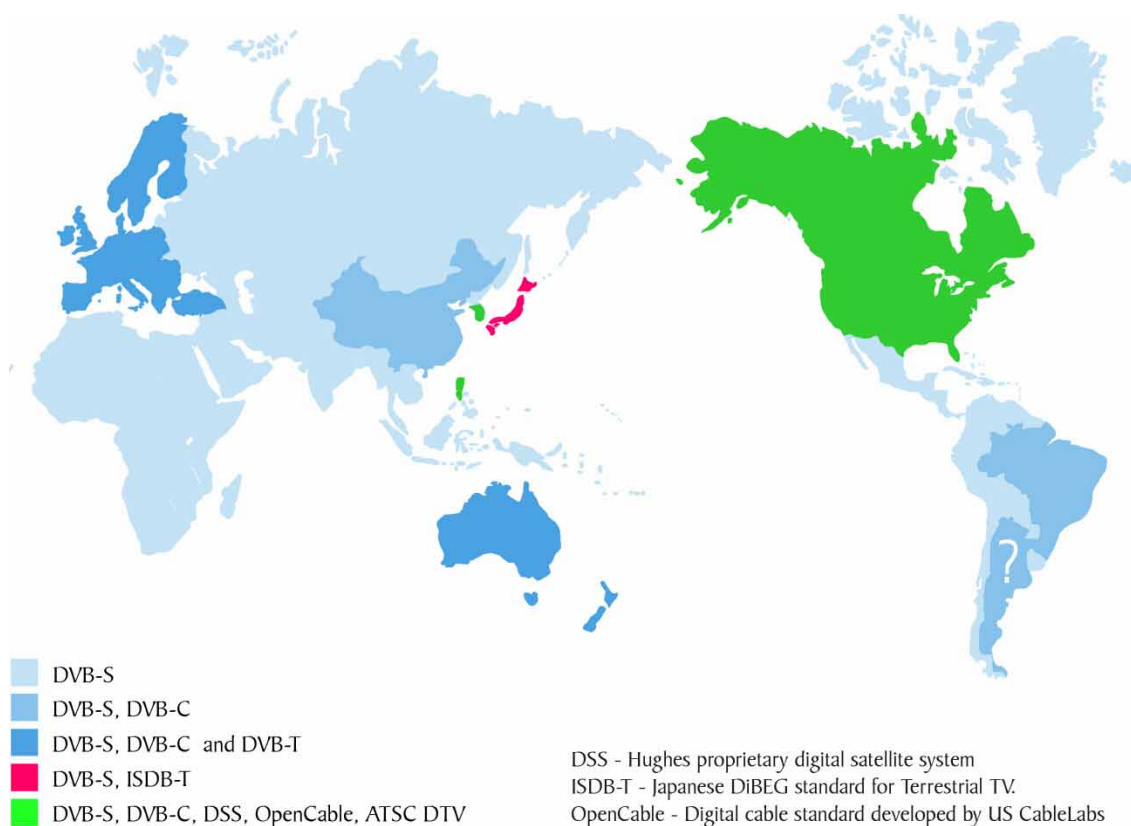


Figure 1: Current Adoption of World Broadcasting Standards

What are the false statements being made about DVB-T?

2. WHAT ARE THE FALSE STATEMENTS BEING MADE ABOUT DVB-T?

The following statements are **false**, and this document will address each one in turn:

- DVB does not support HDTV
- Europe is not implementing HDTV therefore DVB should not be chosen
- The Australian Recommendation for DVB-T was not a decision
- Coexistence of Digital TV and Analogue TV will be difficult
- DVB doesn't support 6 MHz channelling
- DVB has inferior transmission performance
- Single Frequency Networks only work in the laboratory
- It is not necessary to trial digital TV systems

2.1 DVB does not support HDTV - FALSE

DVB supports HDTV. One simple fact. DVB has publicly demonstrated HDTV transmissions for the last three years in Amsterdam, Beijing, Buenos Aires, Hong Kong, Las Vegas, Sydney, Singapore, and Montreux.

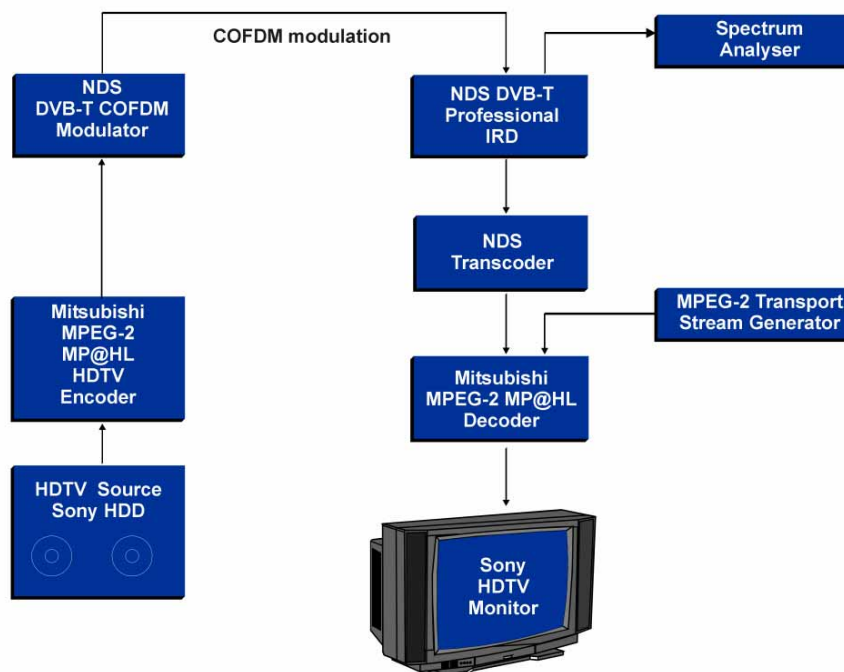


Figure 2: DVB Demonstration of HDTV at NAB Las Vegas USA, 1998

What are the false statements being made about DVB-T?

Whether HDTV or SDTV is broadcast is actually only an "MPEG" issue. All standards that support MPEG-2, like DVB-T, can carry all of the required picture formats.

Like the ATSC system, DVB-T is an MPEG Transport Stream system and supports MPEG Main Profile at High Level (MP@HL) video encoding.

DVB specifications not only explicitly support HDTV (ETR 154), they also represent the fruits of many years of detailed research world-wide into the MPEG-2 compression tools. DVB-T, and all the other DVB family members for other digital broadcast media from DVB-S for satellite to DVB-C for cable, is 100% MPEG-2 compliant and thus is 100% HDTV-ready.

Furthermore, DVB is the only DTV system that can seamlessly deliver an HDTV programme (for example) with a bit rate of up to 24 Mbit/s from the satellite environment to the cable or terrestrial environment, with no need for MPEG-2 decoding and recoding until the signal arrives in the home. This is known as "Cross-medium Interoperability", which is a design feature of the overall DVB System.

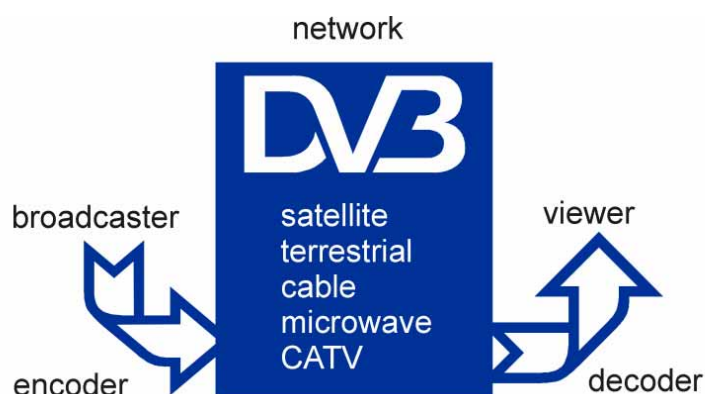


Figure 3: Cross-medium Interoperability

The advantages of this capability are obvious to programme providers and network operators.

DVB has advantages over other systems as it offers a rugged, flexible *and proven* platform for HDTV and / or SDTV, for Fixed Reception and Mobile Reception. Because of this, DVB-T has been recommended for HDTV broadcasting by the Australian Broadcasting industry after extensive objective trials.

European broadcasters have no plans to implement DVB-T HDTV in the immediate future, because, in their context it is too early to do so. No one doubts that the future of broadcasting is HDTV. DVB was designed with HDTV in mind.

What are the false statements being made about DVB-T?

The introduction of HDTV will be made easier by the **hierarchical modulation** solution of DVB, which is already built in to the chipsets currently available.

Hierarchical modulation allows one DVB-T signal to carry a 'high priority' (HP) rugged, low-bitrate service to portable or even mobile receivers, while a 'low priority' (LP) service in the same signal can carry a high bitrate service to rooftop antennas.

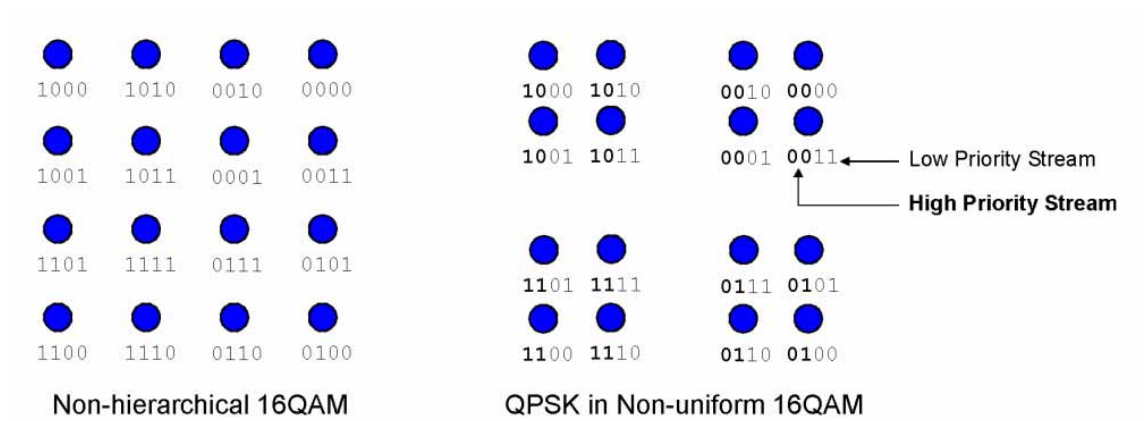


Figure 4: Hierarchical Modulation can be used to carry two totally different service qualities

2.2 Europe is not implementing HDTV so DVB should not be chosen - FALSE

The European broadcasters' view on HDTV is not trivial and should be considered by all businessmen, broadcasters and regulators with an interest in growing digital markets. However, the DVB Project has delivered a technical solution which will work to deliver state-of-the-art HDTV by any broadcaster who wishes to use it.

The reason why European broadcasters have not adopted HDTV in Europe was recently explained by **David Wood**, Head of New Technology at the European Broadcasting Union (EBU):

"There are no known plans by any European organisation to broadcast HDTV in the immediate future. The reasons have nothing to do with the DVB broadcast systems, which are perfectly well able to cope with conventional quality or HDTV, or all things in between.

"The reason is that for the moment, none of the programme service providers see a viable business plan in HDTV, bearing in mind the cost and availability of HDTV receivers, and the cost of HDTV programme production, and public taste. But we are always waiting to hear from someone who has some good ideas about this.

What are the false statements being made about DVB-T?

"You may also know that the quality available from normal broadcasts in Europe (PAL and SECAM) could in some ways be seen as between NTSC and HDTV, so there is less to gain in Europe by going to HDTV anyway.

"Having said that it is widely recognised that the future of television will be HDTV, and we wait and watch what happens in the United States and Australia with their HDTV broadcasts. The DVB systems were definitely designed with HDTV in mind, but with the freedom of the programme service provider to choose what is right for his environment.

"There may also be, as is often the case, something to be gained by being second. Digital compression systems continue to improve, and it could be that in five years time say, it will be possible to use much smaller bit rates for HDTV than are needed today. The PAL and SECAM systems were themselves introduced after NTSC, and could draw on the lessons learned from the launch of NTSC to make a better system.

"The digital conventional quality satellite services in Europe have been relatively successful, especially in France, and the first digital terrestrial services started in the UK just days ago. I am told the digital receivers cannot be made fast enough, so it looks like bearing out the supposition that this will be a market success for conventional quality.

"But, if you have a good business plan for HDTV, everyone would like to know it."

That being said, the context of broadcasting is different for different countries. One of the main reasons for the Australian selection of DVB-T for HDTV, was that the global manufacturing industry guaranteed the availability of 7 MHz DVB-T HDTV receivers. HDTV is right for Australia, and DVB-T gives them the means to provide it, along with many other service options of digital TV.

2.3 The Australian Recommendation for DVB-T was not a decision - FALSE

On June 18th 1998, the Federation of Australian Commercial Television Stations (FACTS) announced the decision of Australia's Digital Terrestrial Television Selection Panel to adopt DVB for standardisation as an Australian broadcasting standard.

The DVB Project is currently actively collaborating with the Australian broadcasting industry to assist the implementation of an HDTV-broadcasting Digital Transition scenario in that country, scheduled to begin in January 2001..

The Selection Panel was comprised of members representing the national broadcasters (ABC and SBS), commercial networks and regional broadcasters, the Department of Communications, the Information Economy and the Arts, and the Australian Broadcasting Authority. In other words, there was representation from every player in the Australian broadcasting community.

What are the false statements being made about DVB-T?

The decision to adopt DVB-T, as described in the Australian press release of 18th June, was "unanimous". The report also made the following explanation of the reasons for the choice:

"Among the criteria assessed, the greatest weight was given to the ability to match existing coverage and to provide satisfactory interoperability with both the present analogue and other digital broadcasting services. Consumer products, and the availability of receivers capable of receiving a high definition service were also important factors. After ratification of the decision by the Department, full development of the detailed standards for Australian DTTB will now be progressed through industry and Standards Australia committees. Draft standards are expected to be completed before the end of 1998."

As can be clearly seen from the Australian announcement and as was clearly understood by all parties to the process, far more criteria than say "clear-sky" Carrier over Noise (C/N) ratios and other details of RF modulation were regarded as fundamentally important. According to the Government laboratory report, while both evaluated systems performed well, neither was regarded as being perfect.

It is also implicit in certain statements by various parties that Australia is reconsidering this choice. This has been dismissed by both the Australian parties to the decision and is now also dismissed by DVB.

It is hardly likely that there is any other DTTB standard under consideration at the moment, while the Australian industry is currently making an Australian standard from the DVB specifications. The Australian implementation of HDTV using DVB-T is due to start in January 2001.

2.4 Coexistence of Digital TV and Analogue TV will be difficult - FALSE

DVB-T has consistently outperformed other digital television systems in testing in an environment where digital terrestrial TV operates in an analogue TV planning environment.

This is the case for digital TV interference into existing analogue TV and vice versa. This advantage is most noticeable where there is co-channel interference from analogue broadcasts. DVB-T is also superior to other systems when it comes to integrating with existing analogue transmissions - that is what DVB-T is designed for.

Figure 5 below shows a screenshot from a spectrum analyser taken during early trial transmissions of DVB-T in Australia, and shows a low powered DVB-T signal in

between two analogue PAL signals. While the DVB pictures were noticeably clearer and sharper, neither the PAL nor the DVB-T signals experienced any interference.

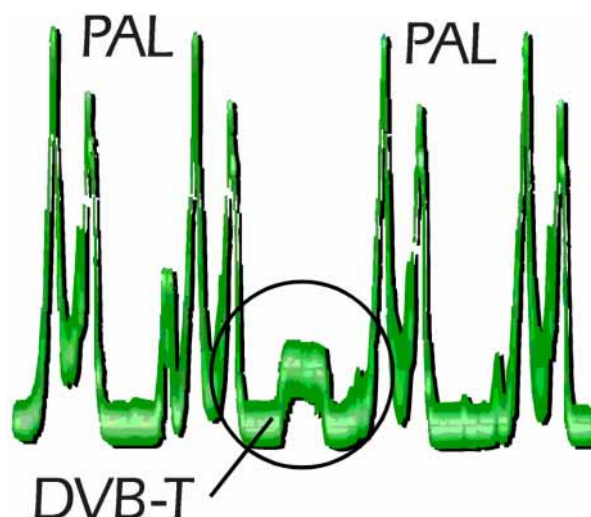


Figure 5: A DVB-T signal in between two analogue PAL signals (Australia 1996)

The US ATSC system makes use of a comb filter to reject co-channel NTSC. This will need re-optimisation for PAL environments. DVB needs no optimisation whatsoever to cope with various different forms of analogue interference. It is designed to be immune to this type of interference from either PAL or SECAM or NTSC services.

2.5 DVB doesn't support 6 MHz channelling - FALSE

Firstly, the DVB-T specification (EN 300 744) explicitly supports 6, 7 and 8 MHz channelling.

Commercial DVB-T receivers and prototype modulators as well as prototype consumer set top boxes are in fact already available in 6 MHz implementations for the Latin American market. They are also available in 7 and 8 MHz implementations for the Australian and European and many other environments.

- The DVB system is currently being deployed in the UK for 16:9 SDTV services through their 8 MHz channels.
- The DVB-T system will be used in Australia for HDTV and SDTV in 7MHz channels.
- In early 1999, 6 MHz DVB-T trials carrying HDTV, SDTV and/or Mobile TV will be carried out in Latin America.

What are the false statements being made about DVB-T?

For DVB-T, the conversion from 8 to 7 to 6 MHz channelling is basically a simple change (in the ratio of channel bandwidths) of the frequency of the clock to the chips in the modulator and the receiver, plus provision of appropriate IF filtering. IF filtering is the main issue in applying DVB systems to 6 or 7 MHz environments.

While DVB already has 6, 7 and 8 MHz receivers, neither the US (ATSC) DTV nor the Japanese (DiBEG) ISDB-T system offers 7 MHz and 8 MHz receivers.

2.6 DVB-T (COFDM) has inferior transmission performance - FALSE

Here it is most useful to compare the multi-carrier COFDM (DVB-T and ISDB-T) system to the single-carrier (8-VSB) ATSC system, as the differences in performance between the ISDB-T and DVB-T systems are marginal. Both DVB-T and ISDB-T use the same advanced COFDM RF modulation technology.

2.6.1 Carrier/Noise (C/N)

The difference in clear-sky C/N ratio between DVB and ATSC is often quoted as 4dB with ATSC being better. This is an overused misconception dating back to very early tests of an ATSC system (the Blue Rack) with an overbalanced trade-off in the direction of clear-sky C/N performance and an early DVB-T hardware prototype. (In addition, clear-sky C/N comparisons take no cognisance of multipath interference - See *point 2.6.2.*)

Tests using the **LSI Logic** (a US-based company) DVB-T chipset, for example, have shown that the clear-sky difference is about 1.4 dB, which is insignificant. This becomes even more insignificant when traded against the major gains in flexibility and multipath performance of DVB-T.

This misconception is due partly to the use of different criteria for measurement and partly to differences in equipment implementations. In theory, there is very little difference between the two systems, even in a Gaussian channel. As soon as multipath comes in, DVB-T outperforms ATSC.

What are the false statements being made about DVB-T?

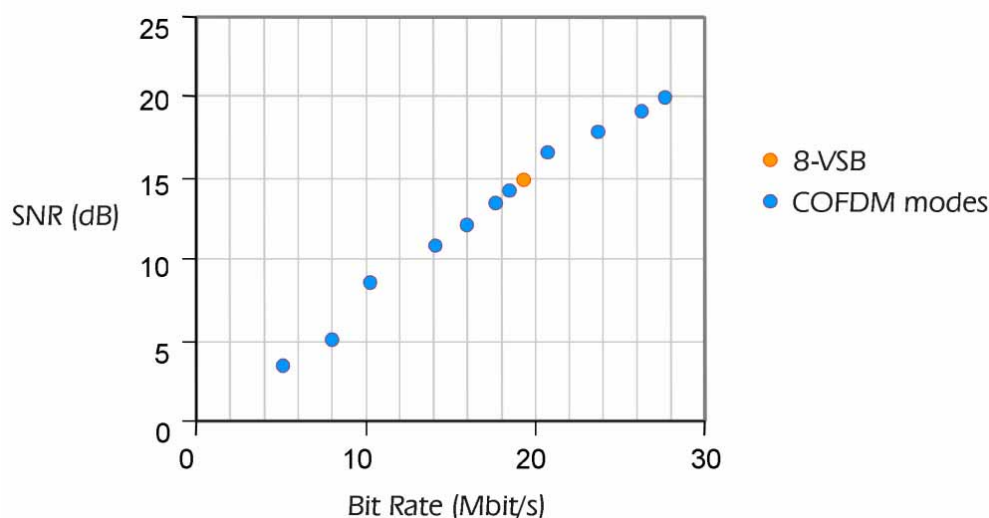


Figure 6: System thresholds for 8-VSB (ATSC) and COFDM (DVB-T)

Note: The diagram above shows the system failure threshold points of COFDM and 8-VSB in 7 MHz channels. 8-VSB is the actual modulation scheme used by all the ATSC systems that have been demonstrated during the course of trials. 16-VSB, as specified in the ATSC standard for cable transmission has never been shown to be useable in a terrestrial broadcasting environment, and is not likely to be adopted in the US, where the 256-QAM CableLabs specification (nearly identical to DVB-C) is likely to be the preferred choice of broadcasters.

Traditionally, ATSC proponents have measured C/N looking for failure (re-occurring visible errors on pictures) whereas DVB measurements have been for the 'quasi error-free' criterion appropriate for service planning of not more than one uncorrectable error per hour. The difference between these two criteria will depend on the DVB-T mode and on the nature of the impairment being tested - for instance, for the 64-QAM rate 2/3 mode being used in the UK the difference to ATSC might be 1-2 dB in a Gaussian channel, but about 4 dB for co-channel interference.

2.6.2 Multipath and Analogue Co-Channel Interference (CCI)

The ATSC receiver contains an adaptive equaliser to reduce the effects of multipath interference, and may contain a comb filter to minimise the effect of analogue NTSC co-channel interference (CCI). Both these components will affect the performance of the receiver; thus an ATSC receiver without the CCI filter will perform better in a

What are the false statements being made about DVB-T?

Gaussian channel than a receiver with the filter, but will be more susceptible to interference.

In implementing ATSC in a PAL environment, there are two choices:

- **Leave the filter alone**, in which case there are constraints on the signal bandwidth and location of the signal within the channel;
- **Redesign the filter**. This is a fundamental change to the system, would mean that US silicon could not be used in PAL countries.

A DVB-T receiver contains a channel estimator which helps it to reject interference such as multipath and CCI. Different algorithms are possible for this channel estimator, offering different compromises between ultimate noise performance and the ability to track rapidly-changing channels. Such channels are typical of portable as well as mobile reception; and aircraft flutter or wind can cause rapid changes even in reception with a fixed rooftop antenna.

The different possible approaches can lead to quite large differences in performance between receivers from different manufacturers, depending on the impairments in the channel. It is possible to design a DVB-T receiver whose performance in a Gaussian channel is very close to theoretical.

But real channels are not Gaussian, and receivers designed to perform well in real channels usually show an implementation margin in a Gaussian channel of 1.5 to 2 dB. Both ATSC and DVB-T receivers can be expected to improve; because of the large number of different DVB-T receivers available on the market, the performance of any one receiver should not be quoted as the definitive performance of the DVB-T system.

This is in fact one of the strengths of DVB - the fact that broadcasters and consumers are free to choose between a number of different added-value implementations of the specifications, all the way down the broadcast chain, without affecting interoperability.

2.6.3 *Universal Coverage*

DVB has been shown in tests to have more uniform coverage inside exactly the same service area as ATSC: in other words, there are fewer pockets of poor reception quality with DVB than ATSC. While ATSC is optimised for achieving wide coverage with high powered transmissions and high masts, DVB makes the coverage more uniform and offers the possibility of universal service coverage.

2.6.4 *Bit-rate*

ATSC offers a single, fixed bit-rate of 19.3 Mbit/s in a 6 MHz channel, whereas DVB-T in 6MHz can have transmission data rates ranging from 3.7-23.8 Mbit/s depending on the choices made by the broadcaster. For 8 MHz systems this bitrate-range is between 4.9 and 31.7 Mbit/s.

This is a key difference: DVB is designed to allow a variable bit rate, unlike ATSC.

The preceding Figure 6 shows this flexibility in bit rate. DVB offers multiple bit rates depending on the Signal-to-Noise Ratio (SNR) desired. High bit-rates are more susceptible than low bit rates, and broadcasters are free to trade off the bit-rate against the robustness of the signal. Thus the ATSC terrestrial system shows only one threshold point where DVB-T shows many.

As can be seen, DVB offers the choice of trading-off the ruggedness and depth of coverage versus the data rate, an option that will be extremely important in years to come.

2.6.5 *Audio Quality*

Audio takes up much less bandwidth than video, and European broadcasters believe that using the world-wide MPEG audio standard was the best formula for broadcasting today. The original tests showed that the performance of MPEG Layer II audio was similar to that of AC-3 for stereo.

Recent tests which compare MPEG-2 Audio and AC-3 in surround sound mode are sometimes misrepresented and AC-3 is sometimes said to have been shown to be better. Yet, according to these tests, AC-3 was better on "pan-pipes", and MPEG-2 was better on "applause". Which of the two sounds are you more likely to hear in an HDTV broadcast?

All independent engineers will tell you that there is not much difference in quality between the two, but on the other hand, the new MPEG-4 Advanced Audio Coding (AAC) produces significantly better quality than either. However, MPEG-4 is not backwards-compatible, and may thus have disadvantages during the transition from analogue to digital broadcasting.

MPEG-2 audio comes into its own where backwards-compatibility with existing (stereo) transmissions is needed. AC-3 needs an external channel mixer to mix roughly six surround sound channels into stereo.

What are the false statements being made about DVB-T?

2.6.6 Mobile Reception

As explained above, a DVB-T receiver can track a rapidly changing channel. This has been shown in the most convincing way possible by tests in Germany where mobile reception has been demonstrated at speeds up to 300 km/h, and also by delivering news, advertising and information services to commuters in trams moving through the "urban canyons" of Cologne.

Mobile reception of DVB-T has recently been demonstrated to great acclaim at the IBC '98 trade exhibition in and around Amsterdam and also in Sydney and Singapore.

This feature of DVB-T also ensures excellent performance in portable reception - an omni-directional antenna can be used despite the multipath that this brings.

It should be noted that while it still needs to be understood just what the commercial viability of Mobile TV is, mobile reception is an *unequivocal* demonstration of the transmission performance of the DVB-T system. If a moving receiver can deliver crystal clear TV, then it is quite obvious that an indoor receiver with just a set top antenna should have no problem either.

The single-carrier 8-VSB modulation used by the ATSC DTV system does not support mobile reception.



Figure 7: DVB-T Mobile TV reception demonstrated on a bus in Singapore

It seems certain that the notebook computers of the future will include digital broadcast reception systems, for receiving data broadcasts, fast access to web content, and television and radio. Making interactive and mobile, or simply portable, services of this nature possible is just one more area where DVB-T scores heavily in comparison to ATSC DTV.

2.7 Single Frequency Networks only work in the laboratory - FALSE

SFNs offer the frequency planner invaluable tools for the introduction of digital TV, especially when it needs to mix in with the analogue world. SFNs are only possible with COFDM technology as used in DVB-T and DAB. A large-area single-frequency network for DAB has been in operation in the UK since 1993, showing all the expected advantages, and in many other European countries.

The diagram below shows how with overlapping signals **on the same frequency**, a DVB-T SFN allows the broadcaster to achieve universal service coverage.

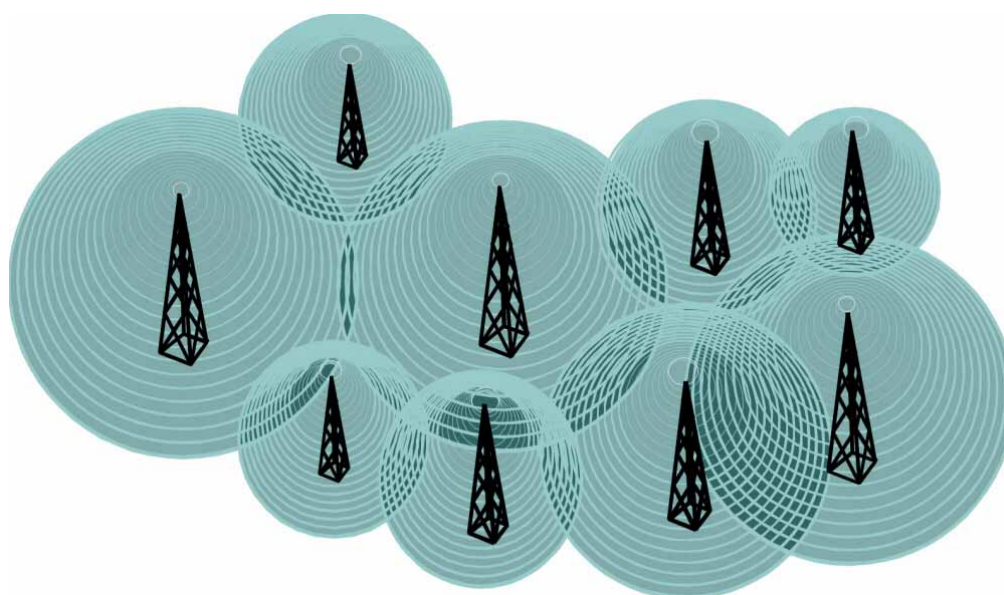


Figure 8: A wide-area Single Frequency Network (SFN)

Thanks to COFDM, a receiver receiving two or more signals on the same frequency actually uses the "interference" to build a stronger signal. The dark areas of overlap in the diagram above thus do not indicate destructive interference but rather network gain.

What are the false statements being made about DVB-T?

With its single-carrier 8-VSB modulation, the ATSC standard cannot be used in Single Frequency Networks.

DVB SFNs can be implemented across wide areas - national or regional - or on a smaller scale for filling gaps in coverage caused by terrain shadowing or high buildings. A domestic gap-filler or on-channel repeater has been developed and tested in the VALIDATE project which has been shown in tests to give portable reception throughout a dwelling in areas of low field strength.

The SFN approach is widely supported and is the basis of planning in Sweden, Italy and Spain. According to a recent announcement by its regulatory body, Italy will launch three nation-wide SFNs when it launches digital terrestrial.

DVB-T SFNs have been demonstrated at the Montreux ITS, in Spain, France, Singapore and in Ireland. A DVB-T SFN has been in service in Berlin for more than a year. It consists of four synchronised transmitters and one on-channel repeater (to serve the town of Potsdam, shaded by hills). The transmitters are about 30 km apart.

On 28th October, Sweden switched its future digital terrestrial television network into live operation. This pilot phase is now on the air and covers 60% of Swedish households, using an SFN. Full commercial launch is expected in January 1999.

The SFN implementation approach has attracted a great deal of very serious interest in Brazil, Japan, Hong Kong, Sweden, Singapore and many other countries.

This widely acknowledged approach to optimising frequency use is yet one more strength of DVB-T.

2.8 It is not necessary to trial digital TV systems - FALSE

While all the member states of Europe are unanimous in their adoption of DVB-T, this follows a very serious and extensive objective validation of the standard, carried out by the VALIDATE project in numerous countries of Europe. In these tests, DVB-T was shown to be perfectly able to meet the demands of all European broadcasters well into the next century.

It is normal engineering practice when evaluating two different technological systems with the same purpose to carry out comparative statistically verified trials.

One thing is sure: no country that has conducted full comparative technical trials of both DVB-T and ATSC has yet adopted ATSC.

2.8.1 *Australia*

The only country to date which has completed full comparative trials is Australia, and the recommendation after these trials was to adopt DVB-T.

Proceeding from the Technical System Recommendation, the task is to define an Australian standard, and this is already underway. Standards Australia and the Australian Broadcasting Authority, in combination with national representative industry groups like FACTS, are working out the final details of adoption of the DVB-T standard.

The documentation produced at the end of the process and released publicly by the Australian Government Communications laboratory had a mass of 15 kg. It took several man-years to make this report. It is a unique event in the history of television and its results simply cannot be dismissed.

2.8.2 *Latin America*

While a recent Argentinean resolution released in favour of the ATSC system in late October 1998 received wide publicity, it has apparently been contested from both within Argentina by members of the Argentine broadcast community and from within the "Mercosur" common trading block which includes Argentina, Brazil, Paraguay and Uruguay.

It has also been contested technically on several points. For example the resolution specifically states that using Single Frequency Networks "will have disastrous consequences".

Recent press reports indicate the Argentine statement has caused serious rifts between regulatory bodies in Brazil and Argentina, who were working on the basis of a Mercosur agreement in 1994 to consult and perform Mercosur-wide trials of Digital Broadcasting before adoption.

The region as a whole suffers from interoperability difficulties based on the unique PAL-M (Brazil) and PAL-N (Argentina) standards, and the intention was for all Mercosur members to adopt the same system.

Recent statements made in the Brazilian media by Renaldo Guerreiro, the president of ANATEL, the Brazilian regulatory body, have made it clear that Brazil will be carrying out comparative trials of the two leading DTT systems, DVB-T and ATSC, without regard to the Argentine statement.

What are the false statements being made about DVB-T?

There is considerable interest in mobile TV in Brazil, and it is expected that the Mobile Reception capability of DVB-T will be tested in addition to HDTV and SDTV delivery.

It is too soon to know which way the situation will develop in Argentina, however apparently the Digital TV Selection Committee which is said to have had modest input to the Argentine decision-making process thus far, has already reconvened for its first meeting since the Argentine statement. In discussions with high-ranking officials of the Argentine Communications Secretariat, DVB has been invited to discuss with them the details of proposed DVB-T trials in January and February.

DVB has been approached by a number of broadcasters in the Buenos Aires area and in the interior interested in carrying out testing of the DVB-T system. The potential superior performance of the DVB-T system in a practical transmission environment, its flexibility to adapt to new services, its more complete series of broadcasting solutions and its interoperability across satellite, cable and terrestrial media were seen as key reasons for wishing to pursue testing.

DVB is confident that under objective testing, the DVB-T system will emerge as the leading digital terrestrial broadcasting solution for the Latin American market as it did in Australia.

2.8.3 *China*

In the People's Republic of China there are various government projects to build demonstrators for HDTV, DVB-T and ATSC. There has certainly been no decision in China towards any of the aforementioned systems.

On 6 October 1998, China mandated the DVB-S standard for all satellite digital television. China is the only country which has a mandatory digital satellite standard, and it is DVB-S.

In addition to a strong interest in HDTV, China has a great degree of interest in a system which supports conditional access. Other digital television systems offer no such support.

2.8.4 *Singapore*

Singapore is in the concluding stages of analysing data from three separate trials of ATSC, DVB-T and the Japanese DiBEG system. The fact that the trials were carried

What are the false statements being made about DVB-T?

out at different times and with different service characteristics means that it will be difficult to compare the results.

For example, the Singapore trials featured tests of ATSC DTV delivering HDTV to rooftop antennas and tests of portable and mobile reception of DVB-T carrying SDTV over a two-transmitter SFN with ATM distribution and terrestrial redistribution of transmodulated DVB-S and DVB-C services. Both the DVB-T and ISDB-T trials featured mobile reception tests.

Singaporean broadcasters are preparing for the deployment of Digital Television with a view to offer their customers not only existing programmes with improved image quality, but also new services now possible with digital technologies.

The recommendation of the Singapore Digital Terrestrial Television Technical Committee is expected around the end of this year. There is considerable interest in HDTV and Mobile Television as niche-markets, the latter application is seen as particularly viable by companies in the public transport sector.

A second series of mobile reception trials of DVB-T will be carried out in December 1998 with the participation of local public transport companies.

Singapore TV terrestrial broadcasters have placed a high priority on mobile reception (in buses, trains, cars...) beside standard- and high-definition broadcasting and data casting or interactive services. For these applications, the flexibility of DVB standards for all media and all content becomes very interesting.

Singapore is an example of a country with a very forward-looking "information society" policy and is expected to announce very shortly an aggressive timescale for the introduction of digital broadcasting. It could also be argued that Singapore is more a big city than a small country. As such, it is predominantly a hostile broadcasting environment: a dense urban location with potential for strong multipath interference.

The solutions offered by DVB standards include not only overcoming hostile reception conditions, SDTV and HDTV programme broadcasting, but also data-casting, pay services and interactive services like broadband Internet-over-the-air to laptop receivers with GSM return channel interfaces.

The robust and flexible COFDM modulation system as used by a now mature DVB-T system, operational in the UK, and the relatively new Japanese ISDB-T standard scheduled to be launched in Japan in the 21st century is attracting most of the interest from Singaporean RF Engineers.

3. WHAT WOULD DVB LIKE TO SAY ABOUT DVB?

3.1 DVB is a complete system

The DVB family of specifications covers every aspect of Digital Broadcasting. DVB started from a principle of being a complete solution for all delivery media, and to make all these media as transparent as possible. In other words, for content providers, DVB systems comprise a system of "pipes" all seamlessly connected eventually delivering MPEG-2 bitstreams to the home. The bitstreams may have been routed through satellite, cable and / or terrestrial networks on the way, but at the end of this process they can be easily decoded. As repeated MPEG-2 decoding and recoding can be costly and damaging to the eventual picture quality, this is an essential feature of DVB.

DVB not only covers all known forms of "one to many" broadcasting, its complete set of return channel specifications allows "many to many" and even in the case of terrestrial DSNG systems for backbone solutions, "one to one".

With its advanced work on the Multimedia Home Platform, or MHP, which includes defining a common API for receivers of the future which will be capable of dealing with many kinds of service and interactivity models, DVB is providing a technical solution to the new, exciting and uncharted territories of digital media convergence.

3.2 DVB is flexible

Using MPEG-2 as a stream of "data containers" labelled with full addressing and processing instructions (in the form of DVB Service Information - SI) DVB provides the receiver at the other end of the "pipe" with the location, network, broadcast and programme information it needs to jump from one element of the multiplex to another and between multiplexes without missing a beat, shifting gear to decode HDTV, SDTV, data, and automatically setting the optimum system parameters.

The Service Information provided to the receiver also facilitates the provision of enhanced Electronic Programme guides, which can go as far as to offer web-browser-like navigation to the programmes you want to see.

3.3 DVB is interoperable

DVB is interoperable in two key senses. Firstly, between different delivery media, where a maximum commonality approach between systems allows problem-free transport of programmes across the barriers between different delivery media. One of the key reasons for the successful implementation of DVB-T receivers in the recent UK launch is that they share many of the same components used in DVB-S and DVB-C receivers made by the same manufacturers and installed in their millions across the world.

This is known as "**cross-medium interoperability**" (see *Figure 3*).

Secondly, all DVB equipment interoperates, which means that equipment from many different manufacturers can be connected together and will work. This allows the content provider, network operator and service provider to freely choose the best added value equipment implementations from various manufacturers all the way down the broadcast chain.

This is known as "**cross-manufacturer**" interoperability.

3.4 DVB is open

Not just a 100% open standard, DVB is also an open system. It is open-ended for whatever might come down the road.

This might be a shift away from the TV set as the platform for convergence, or the emergence of multiple niche-markets specialising in providing mobile broadband data and interactivity to business users, or improvements in compression technology, new enhanced audio and video encoding technologies.

When such developments hit the market, thanks to DVB's ability to respond quickly and address market requirements, standards will be ready.

For example, in the Australian decision process a decision was made to adopt DVB with the audio system used in the ATSC standard. This decision could not have been taken if DVB were not an open system.

As DVB is an open international standard, adopters of DVB technology don't have to worry about the "not-invented here" syndrome.

What would DVB like to say about DVB?

3.5 DVB has the support of the global industry

DVB's work is done by members from all parts of the broadcasting value-chain and lately even members of the computer industry have become active in the working groups of the project. This is a reflection of the natural process of convergence which is a consequence of the widespread digitalisation of all media.

At the moment DVB has 225 members in over 33 countries. The members of DVB may be competitors on the market, but when they gather in their working groups, they are colleagues facing common problems.

DVB engineers have a commitment to technical excellence and are guided by the principle of reaching complete consensus on answering real-world commercial guidelines with a single consensual technical solution. This model of working has produced a set of technical standards that every one of these manufacturers has ownership of and commitment to.

What is even more remarkable is that consensus has been achieved across the board for every major decision.

3.6 DVB is on the air, world-wide

From DVB-T to DVB-S to DVB-C, the DVB system has been very widely adopted. While we don't suggest that DVB-T is adopted anywhere where it hasn't yet been adopted, the commonality between all the DVB systems is an undeniable fact.

It is this commonality which has resulted in the remarkable success of the UK launch of DVB-T in November 1998. These manufacturers have been developing DVB consumer receivers for up to four years with most of the same components for a worldwide installed base of up to 20 million DVB receivers, with as many as 6-million in Europe and 4 million in the United States alone.

It is a fact that in any of the world's big cities, if you put up a satellite dish you will receive a DVB signal.

For the DVB-T market in the UK, it is estimated that up to six competing manufacturers are producing a total of up to 10,000 DVB-T receivers a day. Up to 200,000 boxes are on order for DVB-T and a similar number for UK-based DVB-S satellite services.

More solid information is expected to emerge over the next few months, as digital services roll out across the UK, and DVB-T launches in Sweden and Spain. But this

information will not present any surprises to the dedicated teams of technical experts who have been testing the system thoroughly for the last three years.

3.7 DVB offers extensive implementation support

The valuable forum available to DVB Members extends beyond the research and development and systems design phases though.

Adoption of DVB-T in your country is by no means the end of the process - it is the beginning of a close collaboration with the DVB Project on the details of implementing DVB-T in your market and of course the beginning of a dynamic commercial race between all of the world's largest broadcasting equipment manufacturers to gain market share. DVB specialists will provide complete support to ensure that the DVB-T standard is properly implemented in your country.

Your own experts will of course be welcome to join and contribute to the continuing evolution of Digital Broadcasting. The adoption of DVB-T makes DVB your own system.

4. CONCLUSIONS

DVB recommends that all countries considering the transition to digital perform full comparative trials of all available Digital TV systems.

In addition to these trials, there needs to be careful study of local commercial requirements. Technology should never be implemented simply because it is sophisticated and pleases the creative yearnings of engineers. Issues such as the cost and availability of receivers, the business cases for new enhanced services, and many others need to be carefully considered.

If fundamental changes in technology such as the transformation to digital broadcasting are to benefit the future market they need to answer well-understood market requirements. History is littered with fascinating technical proposals which found no home on the market.

Only by considering these requirements, will it be possible to accurately answer your specific technical and commercial requirements. Not doing this risks a second-class decision about a system which will have impact on every citizen.

We hope that this document assists you in making a well-informed decision. For more information, and to obtain support for comparative trials and information on all other aspects about DVB, please visit the DVB Web Site, or contact the DVB Project Office:

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Good luck with digital television!