

Current Use of the Radio Spectrum: Broadcasting

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16 January 2001

Joint DTI/Oftel Workshop: VDSL and the Radio Spectrum



Focus

- VDSL signals on telephone lines have a broad bandwidth
- some of their energy will inevitably be radiated
- can therefore cause **interference** to radio services
- bands potentially affected are LF, MF and HF
 - low, medium and high frequency, also known as long, medium and short waves respectively (LW/MW/SW)
- these bands have uniquely favourable radio-propagation characteristics
- broadcasters therefore use them extensively
- use of this radio spectrum by radio users (including broadcasting) must be adequately protected from interference — including any from VDSL



Broadcasting in 'bands below 30 MHz' (1)

These bands have a range of uses:

- LF ('long wave')
 - large-area coverage – national and beyond
- MF ('medium wave')
 - local, national and international coverage
- HF ('short wave')
 - international broadcasting, but also national in e.g. tropical countries
- Note also all kinds of receiver intermediate frequencies (IFs) lie in this range

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Broadcasting in 'bands below 30 MHz' (2)

- AM (amplitude modulation) currently used in all 3 bands
- Note high-quality digital replacement developed by Digital Radio Mondiale (DRM)
 - gained draft ITU Recommendation in October 2000
 - will revolutionise broadcasting in these bands
 - better quality, dependability and user-friendliness
- Common feature of these bands is their **favourable propagation characteristics**
 - other frequencies cannot do the same job
 - two different propagation mechanisms occur in these bands, **Ground Wave** and **Sky Wave**

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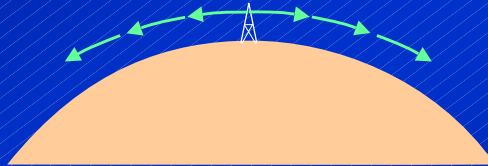
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Propagation at lower frequencies

- At lower frequencies **Ground Wave** is dominant
- It follows the curvature of the Earth



- Large-area coverage is possible
 - depends on power, frequency and surface conditions
 - coverage decreases as frequency increases
 - greater distance over wet ground, greatest over sea

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Propagation at high frequencies (1)

- At higher frequencies **Sky Wave** is dominant
- Waves entering the **ionosphere** are refracted ('bent')
 - bending depends on frequency & ionospheric conditions

high-elevation rays escape altogether, (no use!)

low-elevation rays 'reflected' back to earth can travel long distances

ionosphere

skip distance – shortest range supported by sky wave

- Sky wave is indispensable for international broadcasting
 - no charge, and no gatekeepers!

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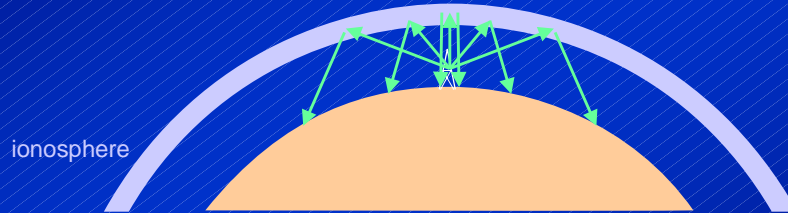
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Propagation at high frequencies (2)

- At lower HF, all rays are 'reflected', supporting **Near-Vertical Incidence Skywave (NVIS)**



- NVIS is used for national broadcasting, especially in the Tropics and for large countries

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Use of LF/MF in UK

- LF & MF extensively used in the United Kingdom
- LF & MF bands contain 137 9-kHz channels
- 75 of these are used in the UK, 50 by multiple services
- BBC provides 40 distinct services
 - national (Radio 4 LW, Radio 5 Live)
 - regional and local
 - external (BBC World Service)
- Also non-BBC — more than 100 distinct services
 - national stations (TalkSport, Virgin)
 - numerous local commercial stations
 - and some low-power services like hospital radio

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Use of HF by BBC

(1)

- **BBC World Service** broadcasts 43 languages to 151 million radio listeners around the world
 - more than 100 million rely on HF or MF (skywave)
 - some countries permit local FM re-broadcasts
- HF/MF vital to reach rural populations or ‘unfriendly’ countries
 - 6000 HF transmitter hours/wk, 2000 MF transmitter hours/wk
- Transmitters in UK and around the globe
- Frequencies depend on season, the 11-year sun-spot cycle and time of day
 - typically, 176 HF and 15 MF frequencies used in a season
 - but not all at once!

BBC

Use of HF by BBC

(2)

- BBC World Service **broadcasts** to other countries
- BBC World Service Monitoring **listens** to them
 - gathers ‘open-source’ information from broadcasts of other countries (domestic and international), press agencies, etc
 - provides valuable economic and political information to HM Government, as well as providing a source of news information for the BBC itself
- Monitors all frequency bands
 - sensitive reception site at Caversham
 - supplemented by manned/unmanned monitoring in some foreign locations
- This work must be protected

BBC

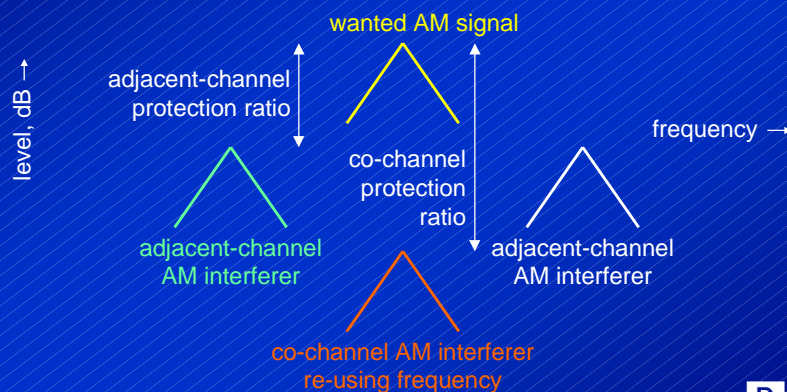
Use of HF by broadcast listeners

- BBC HF broadcasts are intended for other countries
- UK residents are entitled to listen to the broadcasts of other countries
 - only normally possible at LF/MF/HF
 - many countries target UK with English-language broadcasts
 - residents with links to other cultures (& language students) may wish to listen to broadcasts in other languages
 - the right to hear others' views is vital part of democracy
- If UK listeners' reception of foreign stations is compromised, then UK position is weakened
 - more difficult to protest if other countries jam BBC WS

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Protection of radio services (1)

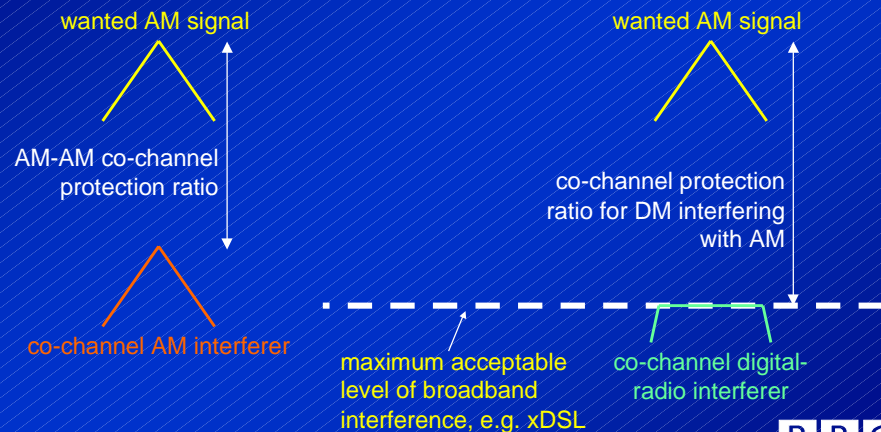
- To permit frequency re-use, broadcasting, like most radio services, allows for an acceptable degree of interference to occur in a planned way



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Protection of radio services (2)

- The protection ratios needed depend on the type of wanted and interfering signals



Protection of radio users from non-radio systems like VDSL etc

- Radio users of the spectrum protected by Radio Regulations from interference from other radio users
 - agreed procedures to follow: planning/co-ordination/...
 - appropriate protection ratios are applied
- Non-radio sources like VDSL should not be permitted to cause greater interference
 - otherwise whole basis of radio planning is threatened → chaos
- Note that the International Table of Frequency Allocations is revised from time to time as uses evolve
 - application of 'chimney' emission limits would prevent this
 - ossification of spectrum
- Bands below 30 MHz have unique utility
 - must not be wasted!

Interference scenarios

- VDSL spectrum spans LF, MF and HF bands
 - potential threat to all of them
- LF/MF mostly portable receivers with ferrite-rod antennas
 - main scenario is interference to indoor reception, inevitably close to wiring carrying VDSL, if listener's home has VDSL
- HF reception has more scenarios:
 - simple receiver with whip – similar problem to LF/MF indoors
 - outdoor antennas can work with lower signal strengths, could be affected by neighbour's VDSL
 - sensitive outdoor-antenna systems could be affected by cumulative interference from a large number of VDSL systems, once VDSL is in widespread use



BBC and xDSL

- BBC keen to co-operate to ensure that xDSL systems can be installed without upsetting radio reception
- BBC took part in experiments last year with BT, RA, and RAu on a trial ADSL system
- We showed how the impact on indoor LF/MF reception could be reduced to acceptable levels
- Requires suppression of common-mode current
 - by proper design of modem input circuit, or
 - by addition of very inexpensive common-mode choke
- Ready to co-operate with further studies of VDSL



LF/MF/HF radio is alive and well (1)

- High-speed digital access like VDSL offers exciting new possibilities which the BBC welcomes

BUT

- Internet delivery cannot replace radio broadcasting
 - impracticably massive infrastructure would be needed to support all broadcast listeners
 - being tethered to a PC does not match present portable and mobile radio listening
 - car, portable, shed in garden, radio 'Walkman' ...
 - unfriendly countries can restrict internet access and trace potential users much more effectively than they could jam or discourage HF reception



LF/MF/HF radio is alive and well (2)

- Satellites do not replace LF/MF/HF either
 - don't serve all present portable/mobile reception locations
 - the satellite operator is an unwelcome gatekeeper
- **So LF/MF/HF radio broadcasting remains popular, necessary and an area for new growth**
 - there is still heavy pressure on frequencies for AM broadcasting
 - there is strong enthusiasm for the digital replacement for AM, Digital Radio Mondiale DRM, which will transform the use of these bands
 - DRM Consortium has more than 60 members
 - includes major international players like BBC, VoA, Sony...
 - website <http://www.drm.org>



Conclusions

- LF/MF/HF bands have unique propagation properties
 - can reach large or remote areas
 - much in demand for national & international broadcasting
 - only reliable form of international broadcasting in times of conflict or crisis, or to reach hostile countries
 - too valuable to lose
 - especially when digital techniques about to transform them
 - cannot be replaced by satellite or internet delivery
- VDSL has *potential* to interfere with these bands
- **Non-radio interferers like VDSL must afford adequate protection to radio users, just as other radio users must**
 - limits to protect radio services from these interferers should align with internationally-agreed radio protection ratios



The End

Thank you for listening

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