

Ofcom

The Likelihood and Extent Of Radio
Frequency Interference From In-Home
PLT Devices

Candidate victim systems above 30MHz

16th December 2009

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Issue: A

1. INTRODUCTION

Following the discussion at the progress meeting you have requested that PA extend the current study to VHF frequencies from 30-300MHz.

For the assessment into the extended spectrum we indicated we would need input from Ofcom on the victim systems on which to focus and we have agreed that to obtain that input we should prepare a short paper for you and your team to review and feedback.

In this document we have assessed the range of users of spectrum in the extended range and provide our recommendations as to the three representative groupings that should be taken forward for detailed analysis.

2. 30-300 MHZ RADIO FREQUENCY USAGE IN THE UK

Future PLT devices (including the new Belkin device using the Gige chipset) are expected to operate using frequencies up to 300MHz. This frequency range is used by other radio and wired communication systems and where the frequencies overlap there is potential for interference. The main wired system using frequencies above 30MHz is cable TV.

The 30 to 300MHz (VHF) range has a wide variety of radio users. This frequency range offers radio systems with engineering that is well proven and economical, having ranges up to and slightly beyond the horizon. Under suitable conditions some over-the-horizon paths can be achieved particularly at the lower end of the frequency range. It is therefore a popular range for wide area coverage of voice and narrowband data systems. It is less suitable for broadband data due to the relatively small bandwidth available compared to the higher UHF and microwave bands that are now available.

In the UK Frequency Allocation Table we have identified the VHF radio user groups to be:

- Broadcast - FM radio
- Land mobile
- Fixed links
- Aeronautical radionavigation
- Aeronautical mobile
- Military fixed, mobile and satellite
- Programme Making and Special Events (PMSE)
- Amateur Radio
- Maritime mobile
- Paging
- Alarms for the elderly and infirm
- Radio controlled models
- Weather radar
- Industrial, Scientific and Medical (ISM)
- Railway video via leaky feeder
- Satellite communications
- Space research

The frequency bands for many of these user types are illustrated in Figure 1.

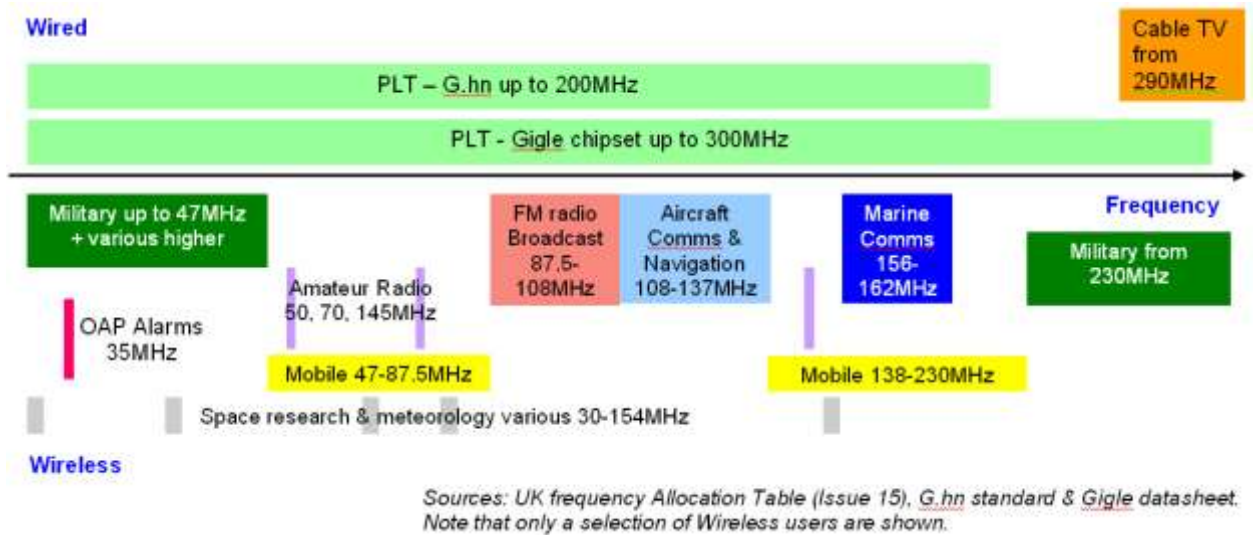


Figure 1 Wired and wireless spectrum usage in the range 30-300MHz

3. **SELECTION OF VICTIM SYSTEMS FOR THE EXTENDED STUDY**

In this section we discuss the merits of including analysis of each of these user groups in the study, commenting on the potential impact of PLT interference. This leads to a priority ranking and recommendation as to the three groups that should be analysed in detail.

- **Broadcast - FM radio.** Broadcast radio stations such as BBC Radios 1 to 4 and commercial radio stations use the 87.5-108MHz band. This attracts many listeners as it is included in nearly all receivers and offers better reception for most users than MW or LW. Broadcast radio as a whole attracts 89% of the UK population at least once a week¹ so interference to this service is likely to impact the largest number of end users. It is therefore considered a high priority.
- **Land mobile** has one of the largest number of licensees, reflecting its many uses. This covers mobile businesses such as taxis and utilities, transport organisations, local authorities, on-site communications such as security guards, telemetry, wide area paging and many others. The variety of users means that a typical user is difficult to define, however the more sensitive installations will use narrowband FM and will be similar in characteristics to a radio amateur. This group is therefore not considered to be a priority for separate analysis.
- **Fixed links** at VHF will typically be narrow band data or voice, similar in characteristics to Land Mobile systems. For the same reasons as Land Mobile it is therefore not modelled as a separate user group.
- **Aeronautical radionavigation** uses the 108 to 118MHz band for the Instrument Landing System Localiser signal (ILS LOC) used at all major airports and for VHF Omnidirectional Range (VOR) radio beacons used for en route navigation. There are also a small number of rarely used beacons that use a band at 75MHz. In poor visibility the ILS signals are the primary means of navigating the aircraft to a safe landing and so interference has major safety implications. Additionally aircraft in flight have been shown to be particularly susceptible to interference from a widespread deployment of PLT. For these reasons this is a high priority.
- **Aeronautical mobile** uses the band from 118 to 137MHz for air traffic control communications. For reasons similar to those above for aeronautical radionavigation, this is considered a high priority.
- **Military fixed, mobile and satellite** has primary user status in all of the VHF range up to 47MHz plus various smaller bands at higher frequencies. The MoD also has many allocations at HF but has not reported problems from the many PLT deployments using HF. As the PLT emission levels are lower and the propagation range is shorter at VHF, this is considered a low priority. A new system 'Link 22' will be introduced in future, but this is an ECM-resistant system so should not be impacted by PLT.

¹ Source: RAJAR figures for 3rd quarter 2009

- **Programme Making and Special Events (PMSE)** at VHF is typically wireless microphones used at public events, in theatres and similar, and talkback facilities used during filming and outside broadcasts. They may also be used for ground to air links that do not fall within the aeronautical communication category. As for other categories, users within a controlled environment such as a theatre, are a low priority for this study as the use of PLT can be limited. The wide area uses are similar to Land Mobile/Amateur Radio or Aeronautical Mobile. Those user groups are therefore taken as proxies for PMSE.
- **Amateur Radio** uses several bands across the VHF range and often operates close to the existing noise floor. Equipment may be fixed, mobile, or handheld and the performance characteristics are similar to those of Land Mobile users. This user group has generated most of the complaints received by Ofcom about PLT interference at HF and so is considered a high priority.
- **Maritime mobile** uses frequencies around 156 to 162MHz for ship to ship and ship to shore. Ship to ship is considered low priority as PLT use is only likely onshore. Ship to shore however includes distress calls and the receiver station is onshore so this use is regarded as a high priority.
- **Paging** has bands allocated for on-site paging systems at 31MHz (hospitals only) and 49MHz (any site). It is assumed that on-site systems are in a location at which PLT use can reasonably be controlled or excluded. All wide area paging systems use either UHF or a few channels within the main Land Mobile VHF band. Analysis of paging as a distinct user group is therefore a low priority.
- **Alarms for the elderly and infirm** have an important safety role and are usually used in a domestic environment. This means that they are liable to be in proximity to wiring carrying PLT signals. Due to the combination of the probability of being exposed to nearby domestic PLT signals and the impact of any problems with the equipment, this user group is considered to be of medium priority for this study.
- **Radio controlled models** have allocations at 35MHz (aircraft) and 40MHz (land and water craft) for control of the models. Downlinks such as video feeds are not permitted in these bands. The only receivers therefore are similar to land or aeronautical mobiles with reduced range and transmitter powers compared to the full sized craft. While model aircraft have the potential to cause a safety hazard if their control is compromised by interference, the models are unlikely to be used in very close proximity to PLT. These are therefore considered low priority for the study.
- **Weather radar** is allocated 46-68MHz as a secondary user that must be co-ordinated with the other users. It is also likely to be located in a controlled area from which PLT can be excluded. It is therefore considered a low priority.
- **Industrial, Scientific and Medical (ISM)** is a licence exempt class of use with no protection from radio interference caused by other ISM users. It is therefore a low priority for assessment of interference caused by PLT.

- ***Railway video via leaky feeder*** is used to enable a train driver to monitor CCTV cameras on the platform (often on underground systems). There is a small distance between antennas and it is in the controlled environment of a railway platform from which PLT can be excluded. It is therefore a low priority for assessment of PLT interference.
- ***Satellite communications*** at VHF are professional communication systems, including military and an allocation at 145MHz for Amateur Radio. VHF is used for both uplink and downlink. Ground stations will tend to have high gain antennas inclined upwards (i.e. not usually towards PLT sources) and so are considered a low priority. Satellites will have many PLT sources within their coverage area, but can be modelled as an extreme case of Aeronautical Mobile.
- ***Space research*** has a primary user allocation at 30.005MHz plus several secondary user allocations. This uses specialised receivers and antennas, and uses various techniques to mitigate noise in order to observe signals well below the existing noise floor. This type of use is sufficiently far removed from most other uses of VHF in the UK that it is not considered to be a priority for analysis.

On the basis of the preceding discussion we have ranked the user groups in order of priority for detailed analysis as shown in Table 1 (0 = low priority, 5 = high priority). This is the same approach that was used in the kick-off meeting for the original study.

User group	Priority ranking
Broadcast - FM radio	5
Land mobile	3
Fixed links	2
Aeronautical radionavigation	5
Aeronautical mobile	4
Military fixed, mobile and satellite	2
Programme Making and Special Events (PMSE)	2
Amateur Radio	4
Maritime mobile	4
Paging	1
Alarms for the elderly and infirm	3
Radio controlled models	1
Weather radar	1
Industrial, Scientific and Medical (ISM)	0
Railway video via leaky feeder	1
Satellite communications	3
Space research	1

Table 1 Priority ranking of VHF user groups (5 = High priority, 0 = Low priority)

Based on the ranking, we recommend the following user groups as the three for more detailed analysis:

1. Broadcast – FM radio listener. Due to the volume of users and the much wider bandwidth (120kHz) compared with typical users in the VHF band
2. Narrowband FM – including Radio Amateur, Aeronautical Mobile and Maritime Mobile. These systems are sufficiently similar (voice services with only a few dB variation in receiver characteristics between groups) that analysis for one type can be readily extended for the other groups.
3. Aeronautical radionavigation. This is a safety critical application operating in view of a potentially large number of PLT interferers and which uses sufficiently different transmission characteristics from voice services to warrant independent analysis.

4. PLT TO CABLE TV INTERFERENCE

In the main study we made a brief assessment of interference from PLT to VDSL. In the extended study we do not propose to examine the potential for interference from PLT to wired cable TV services in any detail.

This is because PLT interference into VDSL at frequencies up to 30MHz required very specific deployment circumstances² and because cable TV services are much less susceptible than VDSL to PLT interference. This is because:

- The PLT emission levels in the cable TV band are much lower than in the VDSL band
- Cable TV is often delivered through optical fibre, which is immune to electrical pickup, rather than copper
- Where copper is used for cable TV it is coaxial cable, which has much greater resistance to picking up stray electrical signals than the untwisted pair telephone cable typically used for VDSL.

² The analysis of PLT to VDSL coupling showed that it would be liable to cause interference only where the mains and VDSL cables run alongside each other with little or no separation for around 5 metres or more.