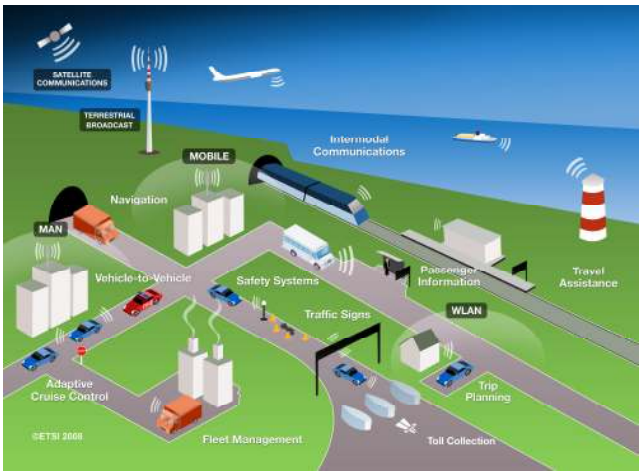
Satellite Earth Stations and ITS

Abstract: Development of an Intelligent Transport System (ITS) can help society improve the safety, reliability, efficiency and quality of transport. Such as system will require a supporting communications infrastructure that will need access to the radio spectrum. Parts of C-band have been proposed, for example 5855– 5925 MHz in Europe, but these frequencies are also used by a number of other services. Studies have shown that there is the potential for interference, particularly if major roads are near transmitters of the fixed service (FS) or fixed satellite service (FSS). This White Paper looks at some of the issues involved and gives the results of example analysis showing the exclusion zones around two satellite earth stations in the UK.

What is ITS?

ITS stands for Intelligent Transport System and covers a wide range of technologies to improve our transport network, with some of the applications shown in the figure below created by European Telecommunications Standards Institute (ETSI):



As can be seen it is intended to cover all types of transport, including aircraft, railways and ships, but the main focus of activity is on supporting road travel.

Two types of communication can be foreseen:

- Vehicle to vehicle: for example a car sending a warning message to other cars when it switches on its hazard signs
- Roadside to vehicle: for example toll networks or warning cars of lane closers

A longer list of applications can be found in Annex A of ETSI TR 102 492-2 with the general aim of improving transport safety, reliability, efficiency and quality.

The frequency bands under consideration for road ITS applications in Europe is 5855– 5925 MHz, and similar allocations are under consideration around the world to ensure that harmonised equipment becomes available.

These frequency bands are also used by a number of other services, as shown by an extract from Article 5 of the ITU-R Radio Regulations in the figure below:

Allocation to services		
Region 1	**Region 2**	**Region 3**
5 830-5 850 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.451 5.453 5.455 5.456	**5 830-5 850** RADIOLOCATION Amateur Amateur-satellite (space-to-Earth) 5.150 5.453 5.455	
5 850-5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.150	**5 850-5 925** FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation 5.150	**5 850-5 925** FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 5.150
5 925-6 700	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 5.149 5.440 5.458	

There is therefore the potential for interference either into or from ITS and a number of other services, including Fixed Service (FS), Fixed Wireless Access (FWA), Fixed Satellite Service (FSS), Mobile, Radiolocation and Radio Amateurs.

Sharing Studies

The issue of sharing between ITS and these other services has been studied by regulatory organisations around the world.

Here in Europe the work was done by the Electronic Communications Committee (ECC), within the European Conference of Postal and Telecommunications Administrations (CEPT).

The result was ECC Report 101: "*Compatibility studies in the band 5855 – 5925 MHz between Intelligent Transport Systems (ITS) and other systems*".

It described the work of a wide range of studies that showed that, while compatibility could be achieved in the majority of cases, there was the potential for interference.

In particular the ITS system could suffer from interference from FS, FWA and FSS systems: the question is how much and at what locations?

The answer will depend upon the characteristics of the FS, FWA and FSS systems and the environment around them.

Example Analysis

To give an idea of how we can analyse these types of scenarios using our Visualyse Professional radio simulation and study tool, we have put together two examples showing interference from a FSS Earth Stations into ITS.

The FSS parameters were extracted from the ITU's Space Radiocommunication Station (SRS) database and the ITS parameters from ECC Report 101.

The simulation files were configured using the parameters given in the tables below.

Simulation Configuration

Propagation model	Rec. ITU-R P.452
Percentage time (%)	50
Delta n (n-units/km)	45
Propagation parameters	IDWM
Terrain data	USGS SRTM
Reference geoid	WGS 84
Output pixel size (m)	100
Threshold pixel blue (dBm)	-88
Threshold pixel red (dBm)	-79
Threshold pixel yellow (dBm)	-65

ITS / DSRC System

Source of data	ECC Report 101
Type	ITS / DSRC
Height above terrain (m)	5
Peak gain (dBi)	8
Vertical beamwidth (deg)	10
Gain pattern	Rec. ITU-R F.1336
Frequency (GHz)	5.9
Bandwidth (MHz)	10
Sensitivity (dBm)	-82
C/I required (dB)	6
TX busy threshold (dBm)	-65

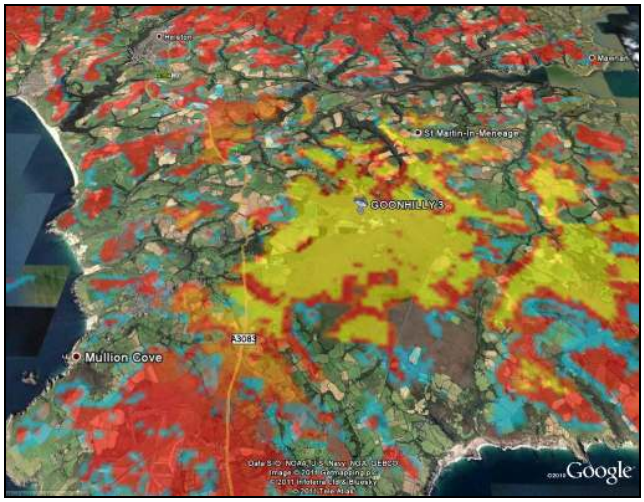
Transmit FSS Earth Station

Two FSS locations were considered, Goonhilly and Whitehill, both in the UK. The SRS database indicates that there are Earth Stations at these locations that transmit at frequencies around 5.9 GHz.

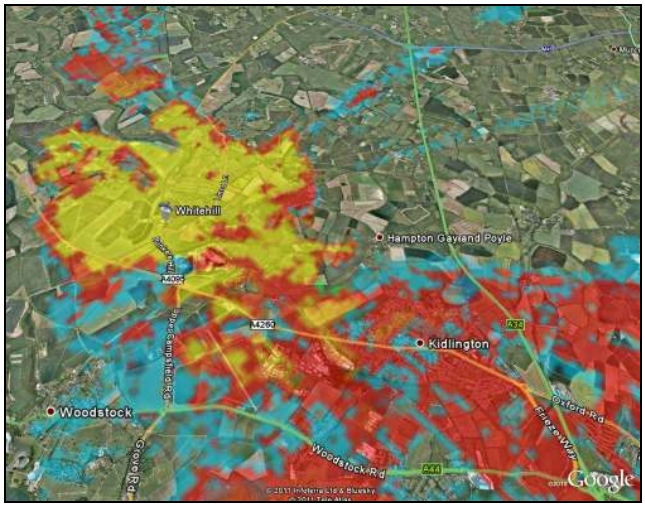
Their parameters are given in the table below.

Source of data	ITU SRS
Type	FSS TX Earth Station
Gain pattern	ITU-R Rec. 465
Frequency (GHz)	5.9
Bandwidth (MHz)	30
EIRP (dBW)	93.0
Site shielding	none

From this information plots of interference zones were created in Visualyse Professional and then displayed using Google Earth, as in the figures below.



At the Goonhilly site (above) the interference catches the hill tops like a stone skimming on the tops of the waves. This includes one A road, though no motorways.



In the figure above of Whitehill the interference is more constrained, though it does cover several A roads and just touches a motorway intersection with an A road.