The role of OSi in Irish life

science & technology in action
www.sta.ie
15th edition

OSi and Geospatial Information

Most of us are familiar with the fact that ***Ordnance Survey Ireland (OSi)*** produces the maps that help us locate physical entities such as villages, towns, cities, rivers, roads and many more of the surface features of our country. Obviously, the type of information shown on such maps (known as ***topographical*** information), is extremely useful. However, many important decisions require more than basic locational information. For example, if a planner is attempting to decide the route of a new motorway, it would be necessary to have access to other possible influences such as population densities or the existence of underground water. In fact, the planner needs accurate information from a number of different ***datasets***. In other words, ***geospatial information*** (***GI***) is required.

This lesson illustrates the critically important role OSi plays in the development and provision of such geospatial resources to assist government ***policy*** and public service decision making. The example used here is the arrival of ***5G*** mobile communications technology.

Policy meets technology

A policy is a high-level overall plan, or course of action, aiming at specific outcomes. Policies are usually based on certain principles and procedures which are set out in the policy document. Government policy is the driver of the ***Public Service Data Strategy***. The strategy includes the requirement for public services to improve service delivery through the use of technology, including geospatial information.

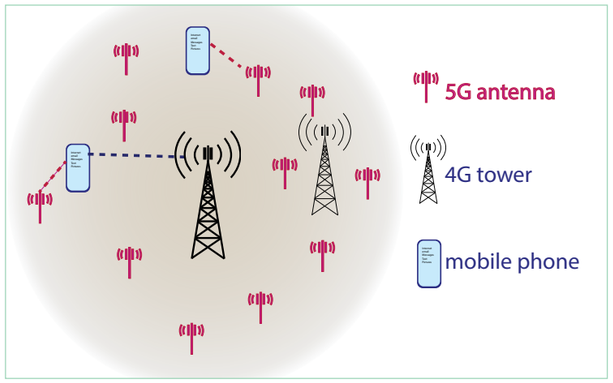
Where are the datasets?

The GI datasets are stored in the OSi National Map Database called ***PRIME2***. Each item recorded, such as a fence, river or building, is known as an 'object'. There are over 50 million 'objects' stored in PRIME2. Accordingly, users can integrate many different data sources to enhance policy, planning and decision making. Under the terms of the ***National Mapping Agreement***, government departments and public sector bodies can access all PRIME2 data free of charge. They do so by logging in to the State's National Geospatial data hub called ***GeoHive***.

What is 5G?

Mobile phone communications have improved dramatically as technology has developed to support faster connections, broader bandwidth and overall higher quality. The earlier technologies of first and second generations could deliver calls and limited text messages. The third generation, 3G, allowed access to the internet and the current 4G allows faster and larger data transfer and smooth surfing. 5G is the coming generation, and is forecast to have a revolutionary impact on business and society in general.

In order to understand some of the issues that arise with the advent of 5G, it is necessary to be familiar with the architecture of a mobile network. Such networks are constructed as a group of areas called



The range and density of 4G and 5G antennas

cells. Each cell is served by a ***base station*** that can connect, by radio waves, to a phone user in the cell. If the user is on a call and moves to another cell, the base station seamlessly hands the call over to the base station in the other cell. The area covered by a cell might be a few square kilometres, although this can vary according to physical circumstances. The familiar tall towers of the base stations carry the ***antennas*** and other electronic equipment.

The cells in a 5G network are much smaller, perhaps by a factor of ten. Accordingly, they are referred to as ***micro cells***. 5G operates on lower power and higher ***frequency*** (which is the same as shorter ***wavelength***) than previous generations. Higher frequencies do not travel as far as lower frequencies, and this means that cells must be smaller. Also, higher frequencies cannot penetrate physical objects such as buildings as easily as those with lower frequencies. Consequently, there must be a direct line of sight between the base station and the user's phone. As a result, there will be many more base stations in densely populated urban areas. However, 5G base station equipment is relatively small and could be placed on existing structures such as street lights, traffic lights and the tops of houses and other buildings. In a dense area, adjacent base stations could be very close together, possibly less than twenty metres apart.

OSi and 5G

Geospatial information is developing as the most critical tool for the analyst, planner and decision maker in many areas of government and business. The advent of 5G is a classic example of this.

Consider the following physical locational requirements of a 5G network.

- The necessity for micro cells and, consequently, for many more base station placements.
- The need for an unobstructed line of site between the base station antenna and the user's phone or other 5G device.

Assume you are a data manager with OSi. Your objective is to recommend the various datasets necessary to assist a network designer to make decisions about the precise location of cell antennae in an urban area. Remember that 5G radio waves require an unobstructed line of sight between the antenna and the phone user. What datasets would you recommend? It becomes clear that the range of datasets required is far beyond anything considered by designers of earlier generation networks. All street furniture, traffic signs, trees and buildings that can obstruct the radio waves, have to be considered. Even likely weather conditions have to be taken into account. The network planners will need to consider scenarios that will illustrate the results of any changes they wish to make concerning the location and height of numerous antennae.

To meet this requirement, OSi facilitates services that provide a range of datasets. Planners and decision makers can then use these datasets to develop a range of scenarios or models for consideration. Such models could include computer generated 3D views of the area involved. These models are known as ***digital twins***, and they provide a cutting-edge approach to such projects, allowing the planner to analyse various scenarios without leaving the office.

5G and radio waves

- Radio waves are located at the low frequency end of the ***Electromagnetic Spectrum*** and span a range from 3 kilohertz (kHz) to 300 gigahertz (GHz).
- The associated wavelengths range from 100 km to 1 mm.
- The radio spectrum is divided into bands from Extremely Low Frequency (ELF) to Tremendously High Frequency (TLF).
- 5G operates in the extremely high frequency (EHF) 30 GHz – 300 GHz band.
- Wavelengths in this band are referred to as ***millimetre waves (MMW)***.
- The UHF (Ultra High Frequency) band has a range of 300 MHz to 3 GHz and can also be used for 5G services.
- ***Bandwidth*** indicates the amount of data that can be transmitted in a given time. High bandwidth means more capacity. 5G can deliver over 1,000 Mbps. In general, 4G operates between 10 and 20 Mbps.
- ***Latency*** is the time it takes for data to travel from sender to receiver. 5G offers lower latency measures than 4G.

What's next?

Ireland, like all EU member countries, considers 5G to be critical to the development of the ***Digital Single Market***. 5G will also drive many other changes in our way of life, influencing technologies such as robotics, driverless cars, wearable devices, the ***Internet of Things (IoT)*** and many others. We will see the advent of revolutionary developments such as ***smart cities*** and smart buildings. Government policy will be a necessary background to these changes.

However, there are multiple variables and uncertainties associated with major policies. In many areas it is virtually impossible to accurately foresee the outcome of decisions. Risk may be present, and the way to minimise such risk is to create as many outcome scenarios as possible. OSi's geospatial information service will be critical to this endeavour. PRIME2 will provide the resources.

Ordnance Survey Ireland performs its mainstream public service function of creating and maintaining the definitive mapping records of the State, as well as developing its commercial business and sales revenues. The work of OSi is essential to the infrastructural development of Ireland and there is a growing recognition among decision makers that knowledge and understanding of location is a key component in effective decision making. To this end, OSi has designed and developed a standardised, authoritative digital referencing framework that enables the consistent referencing and integration of national data related to location. This framework, known as PRIME2, provides the means for GIS data users to accurately integrate and use multiple data sources to provide for better analysis and decision making, optimising resources and delivering efficiencies.

Users of Ordnance Survey Ireland data include

- Government Departments and State Agencies
- Local Authorities
- Corporate Utilities
- Architects and Engineers
- Schools and Universities
- Property and Legal Companies
- Tourists and the General Public

When it comes to the capture of Irish spatial data, OSi are the leaders in terms of national coverage, detail, accuracy and currency (how up to date the data is). The high quality data captured by OSi is fed into PRIME2, making PRIME2 the most authoritative database of spatial information in Ireland.

Ordnance Survey Ireland licenses this data for a variety of applications in the Geospatial (GIS), Construction and Design industries (CAD). Increasingly, industry and Government is accessing OSI data via Web Services platforms including Map Genie and Geohive.

Most OSi products are now available to download online on www.osi.ie. or can be accessed via a network of Agents or directly from OSi.

You can find out more about the work of Ordnance Survey Ireland at **www.osi.ie**

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Syllabus References

The main syllabus references for the lesson are:

Leaving Certificate Geography

- Geographical information systems (GIS) as a specialised investigative tool used to combine data sources in the study of particular areas or geographical problems. (p. 20)

Leaving Certificate Politics and Society

- The making of national policy. Students should be able to describe the process of decision-making at national level in relation to a policy that impacts upon young people. (p. 24)

Leaving Certificate Physics

- Waves: Relationship $c = f\lambda$. Reflection, refraction, diffraction, interference, polarisation. (p. 12)
- Electromagnetic spectrum: Relative positions of radiations in terms of wavelength and frequency. (p. 15)

Leaving Certificate Technology

- Information and Communications Technology (p. 30)

Science and Technology in Action is also widely used by **Transition Year** classes.

Learning Outcomes

On completion of this lesson, students should be able to:

- Define the terms 'geospatial information' and '5G'
- Explain why 5G cells are smaller than those in 4G networks
- Discuss the claimed benefits of 5G
- Identify some issues associated with the advent of 5G
- Outline the value of geospatial datasets for 5G policy and decision makers
- Describe the role of OSi in supporting government policy.

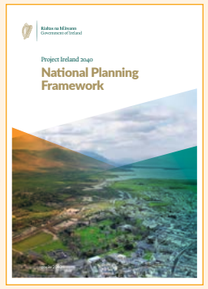
General Learning Points

These are additional relevant points which are used to extend knowledge and facilitate discussion.

- Geospatial activity brings €126.4 million to the economy, directly employing 1,677 people, and supporting the employment of a further 3,087.
- Find out more about the **National Mapping Agreement** at ***https://www.osi.ie/services/national-mapping-agreement/***.
- The ***Public Service Data Strategy 2019/2023*** sets out the policy to improve the management and use of data in the Public Service. The objective is to develop a secure, efficient and transparent process to the benefit of all - citizens, government, business and the Public Service itself. (See ***www.gov.ie***)

Student Activities

1. The government's National Planning Framework sets out several areas for investment. One of these areas is Sustainable Mobility. It deals with the introduction of new technologies such as electric vehicles, and electric and hybrid traction systems for public transport to replace combustion engine driven vehicles.
   - What data objects or datasets do you think would be helpful for those decision makers?



2. There is global debate about possible harmful health problems associated with 5G radio waves. Some countries have suspended installation until more tests are carried out.
   - What datasets would you suggest OSi could put in place to monitor any possible health effects of such radiation in an area?

- **Note:** A search through the National Planning Framework or ***http://irelandsdg.geohive.ie/*** will reveal a wide range of topics for possible projects intended for the BTYSTE or SciFest competitions. Learn more about the National Planning Framework at ***http://npf.ie***

True/False Question

a)	5G mobile network cells are larger than 4G cells.	T F
b)	All EU members are developing 5G in support of the Digital Single Market.	T F
c)	OSi's geospatial hub is called Geohive.	T F
d)	5G antennae must be located at a very high level aboveground.	T F
e)	The geospatial industry contributes significantly to the economy.	T F
f)	Public Service organisations pay a special fee in order to access and use Geohive.	T F
g)	Public Service organisations are committed to using digital technologies.	T F
h)	Geospatial information was first used for decision making in the mid 20th Century.	T F
i)	Geospatial technology will not develop further, having now reached its peak.	T F
j)	The government recognises the importance of geospatial information for policy making.	T F

Check your answers to these questions on www.sta.ie.

Examination Questions

Leaving Certificate Politics & Society (HL) 2018, A: h, i, j

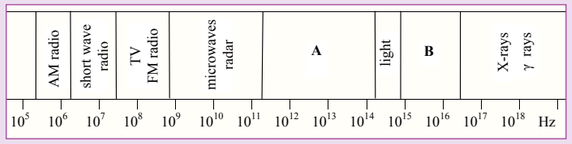
(h) Name two consequences of income inequalities in Ireland on an individual's life chances.

(i) Give one positive effect and one negative effect of economic globalisation.

(j) Name two challenges for regulators of the broadcasting media.

Leaving Certificate Physics (HL) 2012, Q. 7

The diagram shows a simplified version of the electromagnetic spectrum. Name the sections labelled A and B in the diagram.



- Describe how to detect each of these radiations.
- An electromagnetic radiation has a wavelength of 4 m.
- Name the section of the electromagnetic spectrum in which this radiation is located.

Leaving Certificate Physics (HL) 2004, Q. 12 b

- Give two reasons why the telecommunications industry uses optical fibres instead of copper conductors to transmit signals.
- Explain how a signal is transmitted along an optical fibre. An optical fibre has an outer less dense layer of glass. What is the role of this layer of glass?
- An optical fibre is manufactured using glass of refractive index of 1.5. Calculate the speed of light travelling through the optical fibre. (speed of light in air = 3.0×10^8 m s^{-1})

Leaving Certificate Geography (HL) 2007, Q. 9 B

Examine the development of transport/communications or financial services in developed economies, referring to examples you have studied.

Leaving Certificate Technology (OL) 2013, Q. 3 a

WiFi hotspots are often found in public areas such as coffee-shops, hotels and airports. Recently Irish Rail launched free WiFi to customers on train routes across Ireland.

(i) Outline what is meant by the term 'WiFi hotspot'.

(ii) Discuss how work and leisure time can be enhanced for individuals by access to 'WiFi hotspots'.

Leaving Certificate Technology (HL) 2015, Q. 3 a

The use of home broadband connections has made a significant impact on how people access entertainment sources including music, books and film.

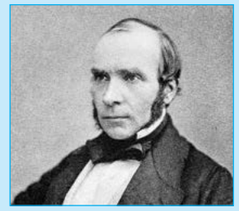
(i) Describe briefly what is meant by a broadband connection.

Did You Know

- A 5G network was used at the 2018 Olympic Winter Games in Pyeongchang, South Korea.
- 5G networks are expected to be operating in Ireland during 2019/20.
- OSi is an Associate Member of the Open Geospatial Consortium (OGC), an international standards organisation for geospatial content and services. Find out more at ***www.opengeospatial.org.***
- The Leaving Certificate now includes a subject named Politics and Society that 'aims to develop the learner's capacity to engage in reflective and active citizenship'. Find out more at ***https://www.curriculumonline.ie.***
- You can see a video on the 'digital twin' being used for 5G network location planning in Bournemouth, England at ***https://www.youtube.com/watch?v=tUmw0RSjzMU***

Biographical Notes

Dr John Snow 1813-1858



Dr John Snow was born on 15 March 1813 in York, England. He graduated from the University of London and was admitted to the Royal College of Physicians. In his time in London, the river was contaminated and streets were very unsanitary. In 1854 a severe outbreak of cholera occurred in the Soho district of the city. By interviewing residents, he discovered that the victims were located in areas that used a particular water pump and convinced the authorities to turn it off. The water companies serving the local pump were using water from the river Thames. At that time, the accepted medical opinion was that cholera was caused by particles in the air. In view of the pattern he proved with his maps, John Snow claimed that it was caused by water contaminated with germs. He is now recognised as a pioneer in the use of geospatial information.

Revise The Terms

Can you recall the meaning of the following terms? Revising terminology is a powerful aid to recall and retention.

antenna, bandwidth, base station, cells, datasets, digital twins, Electromagnetic Spectrum, 5G, frequency, GeoHive, Geospatial information (GI), GHz, latency, Internet of Things (IoT), millimetre waves (MMW), National Mapping Agreement, micro cells, Ordnance Survey Ireland (OSi), policy, PRIME2, Public Service Bodies (PSBs), Public Service Reform Plan, smart cities, topographical, wavelength.

Check the Glossary of terms for this lesson on www.sta.ie