Final report for Ofcom

Impact analysis of socio-economic factors and broadband availability

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Matt Yardley, Ian Adkins, Khooshiram Oodhorah, Declan Clancy

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Annex A Methodology
Impact analysis of socio-economic factors and broadband availability

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Analysys Mason Limited
Exchange Quay
Manchester M5 3EF
UK
Tel: +44 (0)161 877 7808
Fax: +44 (0)161 877 7810
manchester@analysysmason.com
www.analysysmason.com
Registered in England No. 5177472
1 Executive summary

Introduction

Ofcom’s principal duty is to further the interests of citizens and consumers in relation to communications matters. In order to adhere to that guiding principle, it has a number of strategic objectives, including helping communications markets work for consumers, and contributing to and implementing public policy as defined by Parliament.

To inform its work in these areas, Ofcom commissioned Analysys Mason to investigate potential relationships between a selection of socio-economic factors (income, education and crime) and broadband availability (the percentage of ‘less than 2Mbps’ (‘<2Mbit/s’) connections and NGA broadband availability) in six UK cities. This work follows on from research Ofcom previously commissioned Analysys Mason to undertake into the availability of communications services in 11 UK cities.

The six cities that Ofcom has selected for investigation are:

- England: London, Birmingham, Manchester
- Scotland: Glasgow
- Wales: Cardiff
- Northern Ireland: Belfast.

To the best of our knowledge, this type of analysis has not been carried out before.

The analysis has revealed some interesting findings. We have found marked relationships between the degree of socio-economic deprivation and broadband availability in cities, although in this report we do not seek to prove causality. There are also exceptions to some trends; for these we provide some potential reasons to explain the differences.

‘<2Mbit/s’ connections and NGA broadband availability

Using Ofcom’s 2013 broadband availability dataset, the percentage of ‘<2Mbit/s’ connections and NGA broadband availability have been derived for each city studied, as summarised in Figure 1.1.

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1 This study has not investigated inter-correlation between the selected socio-economic factors.
2 NGA broadband availability represents next-generation access broadband from any broadband operator in the UK.
3 See http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/cities-report.pdf
London has the lowest percentage of ‘<2Mbit/s’ broadband connections, whilst Manchester, Glasgow and Cardiff have the highest percentage of ‘<2Mbit/s’ broadband connections (greater than 5%).

With the exception of Glasgow, all cities have NGA broadband availability of more than 86%. Belfast has exceptionally high availability of NGA broadband (98.1%), which most likely reflects the effect of the broadband intervention project initiated by the Department of Enterprise, Trade and Investment in 2009. The relatively low level of NGA broadband availability in Glasgow makes the city particularly suitable for investigating potential relationships between socio-economic factors and broadband availability, and this report includes such analysis.

It should be noted that broadband availability is continually evolving, and there are a number of factors that influence it (such as network operator plans, demand registration and public sector intervention projects), and so the results presented here represent a ‘snapshot’ in time.

In this report we have used quartiles as the basis for our analysis. We considered two quartile analysis definitions and selected one, termed ‘equal domain range’, which highlights better those areas with low broadband availability and acute deprivation.

City-by-city comparison: NGA

As an example, the outputs from our income deprivation quartile analysis of NGA broadband availability for each city are compared in Figure 1.2.

In general, when viewed from the first to the fourth quartile, all cities except Cardiff and Birmingham show an increasing trend in NGA broadband availability when the level of income deprivation decreases, although the variability across quartiles is much more marked for some cities than for others.
Birmingham shows no obvious trend, while Cardiff exhibits a decreasing trend in NGA broadband availability when the level of income deprivation decreases.

Cardiff could be treated as an exception: although the western parts of Cardiff have very low levels of income deprivation, the availability of NGA broadband is limited. This may be explained by factors associated with the high rurality of these parts of the city (e.g. long line length and potential geographical challenges). It is notable that the Welsh Government’s Superfast Cymru rural broadband project will address the NGA broadband availability issues faced in the western parts of Cardiff.

The various trends we have identified between socio-economic factors and NGA broadband availability are summarised in Figure 1.3 below. In this table, increasing trends are shown in green (on the basis that the ‘best’ areas have higher NGA broadband availability), while declining trends are shown in red (on the basis that the ‘worst’ areas have lower NGA broadband availability).
A consistent increasing trend (solid green arrow) means broadband availability increases every quartile from the first to the fourth quartile, whereas an inconsistent increasing trend (green arrow with hatched shading) means broadband availability increases from the first to the fourth quartile, but there is a decrease between two of the quartiles. Using Figure 1.2 above as an example, NGA availability increases in Glasgow between every quartile from the first quartile to the fourth quartile (i.e. there is a “consistent increasing trend”), whereas for Manchester the trend is a general increase from the first to the fourth quartile, but the fourth quartile value is slightly lower than that for the third quartile (i.e. there is an “inconsistent increasing trend”). The same logic is applied to the decreasing trends (red arrows).

From the above table, it can be observed that across the investigated cities, particularly if Cardiff is considered as an exception:

- there is generally an increasing trend in NGA broadband availability when the level of income deprivation decreases
- there is no overall obvious trend in NGA broadband availability when the level of education deprivation decreases
- there is generally an increasing trend in NGA broadband availability when the level of crime rate decreases.

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4 An ‘inconsistent’ trend reflects the anomaly whereby two quartiles contradict the general trend, but the anomaly does not change the overall trend from the first to the fourth quartile.
**City-by-city comparison: ‘<2Mbit/s’**

Similar trends are also observed between socio-economic deprivation factors and the percentage of ‘<2Mbit/s’ broadband connections in a city. As an example, the outputs from our education deprivation quartile analysis are compared in Figure 1.4 below, indicating the percentage of ‘<2Mbit/s’ broadband connections for each city.

*Figure 1.4: Comparison of education deprivation quartile analysis of ‘<2Mbit/s’ connections [Source: Analysys Mason, IMD, Ofcom, 2013]*

In general, when viewed from the first to the fourth quartile, all cities except Cardiff show a decreasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the level of education deprivation decreases, although there is some variability between the second and third quartiles for some cities.

Again, Cardiff could be considered as an exception: although the western parts of Cardiff have a very low level of education deprivation they do have a relatively high percentage of ‘<2Mbit/s’ broadband connections. This may be due to the reasons outlined above for NGA.

The various trends we have identified between the socio-economic factors and ‘<2Mbit/s’ broadband connections are summarised in Figure 1.5 below. In this table, declining trends are shown in green (on the basis that the ‘best’ areas have the lowest percentage of ‘<2Mbit/s’ broadband connections), while increasing trends are shown in red (on the basis that the ‘worst’ areas have the highest percentage of ‘<2Mbit/s’ broadband connections).
Figure 1.5: Impact of socio-economic factors on the percentage of ‘<2Mbit/s’ connections [Source: Analysys Mason, IMD, Ofcom, 2013]

<table>
<thead>
<tr>
<th>Trend in socio-economic indicators</th>
<th>Trend in ‘&lt;2Mbit/s’ broadband connections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glasgow</td>
</tr>
<tr>
<td>When level of income deprivation decreases</td>
<td></td>
</tr>
<tr>
<td>When level of education deprivation decreases</td>
<td></td>
</tr>
<tr>
<td>When level of crime decreases</td>
<td></td>
</tr>
</tbody>
</table>

Key: ↑ Consistent increasing trend  ↘ Inconsistent increasing trend  —— No obvious trend  ↖ Inconsistent decreasing trend  ↓ Consistent decreasing trend

From the above table, it can be observed that across the investigated cities:

- there is generally a decreasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the level of income deprivation decreases
- there is generally a decreasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the level of education deprivation decreases
- there is generally an increasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the level of crime rate decreases.

Concluding remarks

The analysis has demonstrated marked relationships between socio-economic deprivation factors and broadband availability.

It has also highlighted that individual cities have localities where there are acute deprivation issues combined with low NGA broadband availability.

It is also seen that not all cities follow the general trends, but this may reflect the fact that particular districts of each city have unique and sometimes highly localised characteristics that have an impact on broadband availability.

We believe that policy makers seeking to identify ways to stimulate economic growth and investment should investigate broadband-related issues, such as lack of NGA availability and problems with ‘<2Mbits’ connections, using data analysis comparable to that undertaken in this report. An assessment of the links between broadband and socio-economic factors such as income, education and crime can improve understanding of the problems faced by individual UK cities, which are sometimes complex.
The data analysis in this report has only been completed for six cities. Any policy development at the national level would ideally be based on analysis of a wider sample of cities, conducted at a suitably granular level; analysis at postcode level would be necessary as a minimum, but analysis at street level should also be considered. Alternatively, any cities that wish to develop local broadband policies and delivery plans should consider the implications of this analysis as part of the policy development process. In addition, the data analysis could be extended to include other factors which may influence broadband availability, such as unemployment, house prices and existing broadband take-up.
2 Introduction

2.1 Context, objectives and scope

Ofcom’s principal duty is to further the interests of citizens and consumers in relation to communications matters. In order to adhere to that guiding principle, it has a number of strategic objectives, including helping communications markets work for consumers, and contributing to and implementing public policy as defined by Parliament.

To inform its work in these areas, Ofcom has commissioned Analysys Mason to investigate potential relationships between a selection of socio-economic factors and broadband availability (the percentage of ‘less than 2Mbps’ (‘<2Mbit/s’) connections and NGA broadband availability) in six UK cities (London, Birmingham, Manchester, Glasgow, Cardiff and Belfast), which were researched in the Cities Project report.

Consistent with the approach taken in the Cities Project report, the geographical area of each city is determined by the boundaries used by the relevant city local authority. Although the use of local authority boundaries provides a clear and consistent logic for defining city areas, the resulting areas are not entirely consistent in terms of their nature and extent: in some cases, the local authority area extends well beyond the main urban centre, and so includes less densely populated areas.

Information from the Index of Multiple Deprivation (IMD), which characterises deprivation on a national basis, has been used to represent socio-economic factors, and was collected from the government website of each nation. The IMD encompasses a number of ‘domains’, of which this study uses three: income, education and crime.

It is important to use appropriate care when interpreting the deprivation information presented in this report. For example, a decreasing level of income deprivation would be interpreted as positive, while an increasing level of income deprivation would be interpreted as negative.

The broadband data used for this impact analysis was collected by Ofcom from broadband operators in 2013. The data presented in this report constitutes the most up-to-date information at the time of writing, although it should be noted that the broadband availability and IMD datasets are likely to evolve.

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5 This study has not investigated inter-correlation between the selected socio-economic factors.
6 NGA broadband availability represents next-generation broadband from any broadband operator in the UK.
7 See http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr13/cities-report.pdf
8 See http://data.gov.uk/dataset/index-of-multiple-deprivation
9 See http://www.scotland.gov.uk/Topics/Statistics/SIMD
11 See http://www.nisra.gov.uk/deprivation/nimdm_2010.htm
When considering the impact analysis findings presented in this report, readers should note that:

- The impact analysis does not consider key local factors that we would expect to influence the roll-out strategies of broadband operators in a city (e.g. the cost of deployment, population/premises density, existing broadband take-up, legacy infrastructure constraints) or the commercial strategies of operators.

- The data on broadband availability represents a snapshot in time across all broadband operators and cannot reflect the fact that individual operators may have reached different stages of their deployment plans.

### 2.2 Methodology

Analysys Mason has analysed the impact of three socio-economic factors (income, education and crime) on broadband availability, using national IMD domain data and Ofcom’s broadband availability data. Broadband connections and availability have been derived for each Lower Super Output Area (LSOA)\(^\text{12}\) in England and Wales, Data Zone\(^\text{13}\) in Scotland and Super Output Area (SOA)\(^\text{14}\) in Northern Ireland.

Results have been produced for six cities (London, Birmingham, Manchester, Glasgow, Cardiff and Belfast), contrasting the percentage of ‘<2Mbit/s’ connections and NGA broadband availability in each city with the IMD income, education and crime domain scores. In each case the results are broken down by quartile. Two alternative quartile analysis methods have been applied, as summarised in Figure 2.1.

**Figure 2.1: Description of quartile analysis methods used [Source: Analysys Mason, 2013]**

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal domain range</td>
<td>This method defines each quartile as the difference between maximum and minimum values of scores in the IMD domain divided by four. The upper and lower scores of each quartile will be different for each city depending on its range of scores for the given IMD domain. Therefore, the number of premises in each quartile will be different. This method has been chosen as a way of highlighting acute deprivation relative to the rest of the nation.</td>
<td>This method highlights the NGA broadband availability for areas of the city that fall into the 25% most deprived areas.</td>
</tr>
<tr>
<td>Equal premises count</td>
<td>This method defines each quartile as the total number of premises in a city divided by four. Therefore, the number of premises in each quartile will be the same. This method has been chosen as a way of highlighting the relative differences in deprivation within a city.</td>
<td>This method highlights the NGA broadband availability for areas that represent the 25% most deprived premises in the city.</td>
</tr>
</tbody>
</table>

\(^{12}\) An LSOA is a sub-ward geographical area averaging approximately 1500 people, as published by the Office of National Statistics and widely used by local authorities across England and Wales.

\(^{13}\) A Data Zone is a group of small geographical areas with populations of between 500 and 1000 household residents, as published by Scottish Neighbourhood Statistics and widely used by local authorities across Scotland.

\(^{14}\) An SOA is a group of wards taking into account measures of population size (lower and upper thresholds are 1300 and 2800 respectively, but with a target size of around 2000) and mutual proximity, as published by the Northern Ireland Statistics and Research Agency and widely used by local authorities across Northern Ireland.
Geographical maps based on quartile ranges have also been developed using these two methods. These allow the most deprived and least deprived areas to be quickly identified from the colour coding on the maps.

Key observations are drawn from the quartile analysis charts and geographical maps for each city, and in some cases known local factors (such as public intervention) are used to provide potential explanations for the analysis shown.

A full description of the methodology used for the analysis is provided in Annex A.

2.3 Report structure

The remaining sections of this report are structured as follows:

- Section 3 contains the impact analysis for London
- Section 4 contains the impact analysis for Birmingham
- Section 5 contains the impact analysis for Manchester
- Section 6 contains the impact analysis for Glasgow
- Section 7 contains the impact analysis for Cardiff
- Section 8 contains the impact analysis for Belfast
- Section 9 contains a comparison of key city data.

In addition, Annex A provides a full description of the methodology used for quartile analysis.
3 Impact analysis: London

3.1 City overview

The city boundary of London is defined as the Greater London Authority (GLA) geographical boundary, as shown in Figure 3.1 below.

According to the 2011 census, London has a population of around 7.8 million and around 3.4 million premises, of which 3.2 million are residential premises.

3.2 Broadband availability

Using the Ofcom 2013 dataset, the percentage of ‘<2Mbit/s’ connections is estimated as 3.7% of all broadband connections across London, and NGA broadband availability is estimated to reach 88.4% of all premises across London. Maps showing broadband availability in London are provided in Figure 3.2 (‘<2Mbit/s’ connections) and Figure 3.3 (NGA broadband availability) below.
Areas with the highest percentage of ‘<2Mbit/s’ connections (worst areas), shown in red in Figure 3.2, are mostly concentrated around the outskirts of London; most of the city has a low percentage of ‘<2Mbit/s’ connections (between 0% and 5%).

Low levels of NGA broadband availability (worst areas), shown using red in Figure 3.3, are mostly concentrated in the city centre, while the rest of the city is well served with NGA broadband. The low level of NGA broadband availability in these areas could be due to the relatively high numbers of non-residential premises (which attract business-grade connectivity), and a relatively low population density.

Figure 3.3: NGA broadband availability in London [Source: Analysys Mason, Ofcom, 2013]

Generally, the areas with a high level of ‘<2Mbit/s’ connections do not correspond to areas with low NGA broadband availability, so there does not seem to be a relationship between the two that has affected NGA broadband availability in London.

It should be noted that this analysis of broadband availability provides a snapshot in time, because it is expected that broadband roll-out will continue to evolve, provided that, for example:

- investment conditions remain attractive for broadband operators, and
- the demand stimulation intervention project in London’s Super-Connected Cities programme progresses.

3.3 Impact analysis findings

There are 4765 LSOAs in London, and the broadband availability for each LSOA is derived using the Ofcom 2013 dataset. The impact analysis findings for the three measures of deprivation (income, education and crime) are provided in this section, using both methods (equal domain range and equal premises count).
3.3.1 Income

**Equal domain range method**

Figure 3.4 below shows the distribution of income deprivation across London, using the equal domain range method.

![Map of income deprivation in London](image)

It can be seen that a much lower proportion of LSOAs are in the most ‘income deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles. In contrast, there is a more even distribution of LSOAs across the other three quartiles.

Figure 3.5 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by income deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.

![Quartile analysis graph](image)
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in London there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.6 percentage points between the most and least ‘income deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases slightly from the second to the fourth quartile, and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 4.9 percentage points between the most and least ‘income deprived’ quartiles)
  — NGA broadband availability decreases slightly from the third to the fourth quartile.

*Equal premises count method*

Figure 3.6 below shows the distribution of income deprivation across London using the equal premises count method.

![Figure 3.6: Distribution of income deprivation across London using equal premises count method [Source: Analysys Mason, IMD, 2013]](image)

It can be seen that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘income deprived’ areas of London are mostly in the north-east of the city.

Figure 3.7 below provides quartile analysis by income deprivation using the equal premises count method. The right-hand vertical axis represents the percentage of premises considered in each quartile (which is the same for each quartile using the equal premises count method).
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in London there is:

- **no obvious quartile-to-quartile trend** in the percentage of ‘<2Mbit/s’ connections, and
- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 2.1 percentage points between the most and least ‘income deprived’ quartiles)
  — NGA broadband availability decreases slightly from the third to the fourth quartile.

### 3.3.2 Education

**Equal domain range method**

Figure 3.8 on the following page shows the distribution of education deprivation across London using the equal domain range method.
Impact analysis of socio-economic factors and broadband availability

Figure 3.8: Distribution of education deprivation across London using equal domain range method [Source: Analysys Mason, IMD, 2013]

It can be seen that the proportion of LSOAs in the least ‘education deprived’ quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map) is much higher than in the other quartiles. In contrast, there is a more even distribution of LSOAs across the other three quartiles.

Figure 3.9 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by education deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.

Figure 3.9: Education deprivation analysis for London using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of education deprivation decreases (representing areas with higher levels of educational attainment) in London there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 1.6 percentage points between the most and least ‘education deprived’ quartiles), and
- a **consistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 10.8 percentage points between the most and least ‘education deprived’ quartiles).

### Equal premises count method

Figure 3.10 below shows the distribution of education deprivation across London using the equal premises count method.

![Figure 3.10: Distribution of education deprivation across London, using equal premises count method](image)

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘education deprived’ areas in London are concentrated in the north-east of the city.

Figure 3.11 below provides quartile analysis for education deprivation using the equal premises count method.
From the chart above, it can be observed that when the level of education deprivation decreases in London there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 1.4 percentage points between the most and least ‘income deprived’ quartiles), and
- an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 1.2 percentage points between the most and least ‘education deprived’ quartiles) — NGA broadband availability increases between the third and the fourth quartile, despite the general trend.

### 3.3.3 Crime

**Equal domain range method**

Figure 3.12 below shows the distribution of crime rate levels across London using the equal domain range method.
It can be seen that a much smaller proportion of LSOAs lie in the lowest crime rate level quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map) than in the other quartiles. However, there are a high proportion of LSOAs in the second-highest crime rate level (coloured in yellow, denoting the ‘25%–50%’ range on the map).

Figure 3.13 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by crime rate level. The right-hand vertical axis represents the percentage of premises considered in each quartile.
From the chart above, it can be observed that when the level of crime rate decreases in London there is:

- **a consistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.6 percentage points between the highest and lowest crime rate level quartiles), and
- **an inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 30.8 percentage points between the highest and lowest crime rate level quartiles), which is surprising
  — NGA broadband availability increases between the first and second quartile, despite the general trend.

*Equal premises count method*

Figure 3.14 below shows the distribution of crime rate levels across London using the equal premises count method.

![Figure 3.14: Distribution of crime rate levels across London using equal premises count method [Source: Analysys Mason, IMD, 2013]](image)

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the areas with the highest crime rate levels in London are scattered across the city.

Figure 3.15 below provides quartile analysis for the crime rate level using the equal premises count method.
From the chart above, it can be observed that when the crime rate decreases in London there is:

- **an inconsistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.8 percentage points between the highest and lowest crime rate level quartiles)
  — the percentage of ‘<2Mbit/s’ connections does not change between the second and third quartile, and

- **a consistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 4.1 percentage points between the highest and lowest crime rate level quartiles), which is surprising.

### 3.3.4 Summary

As illustrated above, the two methods produce very similar results. However, since the equal domain range method highlights acute deprivation problems relative to the country as a whole, it is those results which are discussed in this section.

Key observations from the impact analysis of socio-economic factors on broadband availability for London are summarised in Figure 3.16 below.
The analysis shows that there is a potential relationship between income and education deprivation and the percentage of ‘<2Mbit/s’ connections, because there is generally a decreasing trend in ‘<2Mbit/s’ connections when the levels of income and education deprivation decrease. In addition, it appears that there is a potential relationship between crime rate levels and the percentage of ‘<2Mbit/s’ connections, because there is generally an increasing trend in ‘<2Mbit/s’ connections when the level of crime decreases.

Moreover, the analysis shows that there is a potential relationship between income deprivation and NGA broadband availability, because there is an increasing trend in NGA broadband availability when the level of income deprivation decreases. However, when levels of education deprivation and crime rate decrease, the NGA broadband availability generally decreases. This trend could be explained by the fact that NGA broadband availability is very low in the city centre (which has a high number of non-residential premises and relatively low population density), and levels of education deprivation and crime rate are also low in this area.

It should be noted that attempts to investigate potential relationships between socio-economic factors and NGA broadband availability may be limited by the fact that London already has high NGA broadband availability (88.4%). Also, it should be recognised that there are other factors which influence broadband roll-out; for example, it is well established that issues related to cost (e.g. premises density and line length) and take-up are significant considerations.
4 Impact analysis: Birmingham

4.1 City overview

The city boundary of Birmingham is defined as the Birmingham City Council geographical boundary, as shown in Figure 4.1 below.

According to the 2011 census, Birmingham has a population of around 1.0 million and around 445 000 premises, of which 427 000 are residential premises.

4.2 Broadband availability

Using the Ofcom 2013 dataset, the percentage of ‘<2Mbit/s’ connections is estimated as 4.2% of all broadband connections across Birmingham and NGA broadband availability is estimated as reaching 91.3% of all premises across Birmingham. Maps showing broadband availability in Birmingham are provided in Figure 4.2 (<2Mbit/s’ connections) and Figure 4.3 (NGA broadband availability).
Areas with the highest percentage of ‘<2Mbit/s’ connections (worst areas), shown using orange in Figure 4.2, are scattered across the city; most of the city has a low percentage of ‘<2Mbit/s’ connections (between 0% and 5%).
Low levels of NGA broadband availability (worst areas), shown using red in Figure 4.3, are concentrated in the city centre, while the rest of the city is well served with NGA broadband. The low level of NGA broadband availability in these areas could be due to the relatively high numbers of non-residential premises (which attract business-grade connectivity), and a relatively low population density.

Generally, the areas with a high percentage of ‘<2Mbit/s’ connections do not correspond to areas with low NGA broadband availability, so there does not seem to be a relationship between the two that has affected NGA broadband availability in Birmingham.

It should be noted that broadband availability provides a snapshot in time, because it is expected that broadband roll-out will continue to evolve, provided that, for example:

- investment conditions remain attractive for broadband operators
- the demand stimulation intervention project in Birmingham’s Super-Connected Cities programme progresses.

4.3 Impact analysis findings

There are 641 LSOAs in Birmingham and the broadband availability for each LSOA is derived using the Ofcom 2013 dataset. The impact analysis findings for the three measures of deprivation (income, education and crime) are provided in this section, using both methods (equal domain range and equal premises count).

4.3.1 Income

*Equal domain range method*

Figure 4.4 below shows the distribution of income deprivation across Birmingham using the equal domain range method.

It can be seen that a much lower proportion of LSOAs are in the most ‘income deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles. In contrast, there is a more even distribution of LSOAs across the other three quartiles.
Figure 4.4: Distribution of income deprivation across Birmingham using equal domain range method [Source: Analysys Mason, IMD, 2013]

Figure 4.5 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by income deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.

Figure 4.5: Income deprivation analysis for Birmingham using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Birmingham there is:

- **a consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 2.5 percentage points between the most and least ‘income deprived’ quartiles), and
- **no obvious quartile-to-quartile trend** in NGA broadband availability.

**Equal premises count method**

Figure 4.6 below shows the distribution of income deprivation across Birmingham using the equal premises count method.

![Distribution of income deprivation across Birmingham](image)

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘income deprived’ areas of Birmingham are mostly concentrated around the city centre.

Figure 4.7 below provides quartile analysis by income deprivation using the equal premises count method. The right-hand vertical axis represents the percentage of premises considered in each quartile, which is the same for each quartile using the equal premises count method.
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Birmingham there is:

- an inconsistent quartile-to-quartile decreasing trend in the percentage of ‘<2Mbit/s’ connections (a difference of 1.5 percentage points between the most and least ‘income deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases slightly between the third and the fourth quartile, and

- no obvious quartile-to-quartile trend in NGA broadband availability.

### 4.3.2 Education

**Equal domain range method**

Figure 4.8 below shows the distribution of education deprivation across Birmingham using the equal domain range method.

It can be seen that the proportion of LSOAs in the most ‘education deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) is much lower than in the other quartiles. In contrast, there is a more even distribution of LSOAs across the other quartiles.
Figure 4.8: Distribution of education deprivation across Birmingham, using equal domain range method [Source: Analysys Mason, IMD, 2013]

Figure 4.9 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by education deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.

Figure 4.9: Education deprivation analysis for Birmingham using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of education deprivation decreases (representing areas with higher levels of education) in Birmingham there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 5.6 percentage points between the most and least ‘education deprived’ quartiles), and
- an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 3.5 percentage points between the most and least ‘education deprived’ quartiles) — NGA broadband availability increases from the third to the fourth quartile, despite the general trend.

**Equal premises count method**

Figure 4.10 shows the distribution of education deprivation across Birmingham using the equal premises count method.

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘education deprived’ areas in Birmingham are in the central and southern parts of the city.

Figure 4.11 below provides quartile analysis for education deprivation using the equal premises count method.
From the chart above, it can be observed that when the level of education deprivation decreases (representing areas with higher levels of education) in Birmingham there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 3.1 percentage points between the most and least ‘income deprived’ quartiles), and
- an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 5.1 percentage points between the most and least ‘education deprived’ quartiles) — NGA broadband availability increases between the second and third quartile, despite the general trend.

### 4.3.3 Crime

*Equal domain range method*

Figure 4.12 below shows the distribution of crime rate levels across Birmingham using the equal domain range method.
Impact analysis of socio-economic factors and broadband availability

It can be seen that a much lower proportion of LSOAs lie in the lowest crime rate level quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map) than in the other quartiles. In contrast, there is a more even distribution of LSOAs across the other three quartiles.

Figure 4.13 provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by crime rate level. The right-hand vertical axis represents the percentage of premises considered in each quartile.
From the chart above, it can be observed that when the crime rate decreases in Birmingham there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.8 percentage points between the highest and lowest crime rate level quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases slightly from the first to the second quartile, and

- a **consistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 14.8 percentage points between the highest and lowest crime rate level quartiles).

*Equal premises count method*

Figure 4.14 below shows the distribution of crime rate levels across Birmingham using the equal premises count method.

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that areas with the highest crime rate levels in Birmingham are scattered across the city.

Figure 4.15 below provides quartile analysis for the crime rate using the equal premises count method.
From the chart above, it can be observed that when the crime rate decreases in Birmingham there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.6 percentage points between the highest and lowest crime rate level quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases slightly from the second to the third quartile, and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 7.5 percentage points between the highest and lowest crime rate level quartiles)
  — NGA broadband availability increases between the third and fourth quartile, despite the general trend.

### 4.3.4 Summary

As illustrated above, the two methods produce very similar results. However, since the equal domain range method highlights acute deprivation problems relative to the country as a whole, it is those results which are discussed in this section.

Key observations from the impact analysis of socio-economic factors on broadband availability for Birmingham are summarised in Figure 4.16 below.
Figure 4.16: Key observations on impact analysis for Birmingham using equal domain range method [Source: Analysys Mason, 2013]

<table>
<thead>
<tr>
<th>Socio-economic factor</th>
<th>Key observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>• There is a <strong>consistent</strong> quartile-to-quartile decreasing trend in the percentage of ‘&lt;2Mbit/s’ connections when the level of income deprivation decreases.</td>
</tr>
<tr>
<td></td>
<td>• There is no <strong>obvious</strong> quartile-to-quartile trend in NGA broadband availability when the level of income deprivation decreases.</td>
</tr>
<tr>
<td>Education</td>
<td>• There is a <strong>consistent</strong> quartile-to-quartile decreasing trend in the percentage of ‘&lt;2Mbit/s’ connections when the level of education deprivation decreases.</td>
</tr>
<tr>
<td></td>
<td>• There is an <strong>inconsistent</strong> quartile-to-quartile decreasing trend in NGA broadband availability when the level of education deprivation decreases.</td>
</tr>
<tr>
<td>Crime</td>
<td>• There is an <strong>inconsistent</strong> quartile-to-quartile decreasing trend in the percentage of ‘&lt;2Mbit/s’ connections when the crime rate decreases.</td>
</tr>
<tr>
<td></td>
<td>• There is a <strong>consistent</strong> quartile-to-quartile increasing trend in NGA broadband availability when the level of crime rate decreases, which is not apparent with the other socio-economic factors.</td>
</tr>
</tbody>
</table>

The analysis shows that there is a potential relationship between the investigated socio-economic factors and the percentage of ‘<2Mbit/s’ connections, because there is a **decreasing trend** in the percentage of ‘<2Mbit/s’ connections when the level of deprivation decreases in all domains.

However, the analysis does not demonstrate that income deprivation has influenced the roll-out of NGA broadband by fixed operators, because there is no obvious trend between this socio-economic factor and NGA broadband availability. In addition, when the level of education deprivation decreases, NGA broadband availability also generally decreases. This trend could be explained by the fact that NGA broadband availability in the city centre (which has a high number of non-residential premises and relatively low population density) is very low, as are levels of education and crime deprivation. However, there is an **increasing trend in NGA broadband availability when the level of crime rate decreases**.

It should be noted that attempts to investigate potential relationships between socio-economic factors and NGA broadband availability may be limited by the fact that Birmingham already has high NGA broadband availability (91.3%). Also, it should be recognised that there are other factors that influence broadband roll-out; for example, it is well established that issues related to cost (e.g. premises density and line length) and take-up are significant considerations.
5 Impact analysis: Manchester

5.1 City overview

The city boundary of Manchester is defined as the Manchester City Council geographical boundary, as shown in Figure 5.1 below.

According to the 2011 census, Manchester has a population of around 0.5 million and around 229,000 premises, of which 217,000 are residential premises.

5.2 Broadband availability

Using the Ofcom 2013 dataset, the percentage of ‘<2Mbit/s’ connections is estimated as 5.5% of all broadband connections across Manchester, and NGA broadband availability is estimated as 86.3% of all premises across Manchester. Maps showing broadband availability in Manchester are provided in Figure 5.2 (‘<2Mbit/s’ connections) and Figure 5.3 (NGA broadband availability).

Areas with the highest percentage of ‘<2Mbit/s’ connections (worst areas) are shown using red in Figure 5.2; most of the city has a low percentage of ‘<2Mbit/s’ connections (between 0% and 5%).
Figure 5.2: ‘<2Mbit/s’ connections in Manchester [Source: Analysys Mason, Ofcom, 2013]

Figure 5.3: NGA broadband availability in Manchester [Source: Analysys Mason, Ofcom, 2013]
Low levels of NGA broadband availability (worst areas), shown using red in Figure 5.3, are mostly concentrated in the city centre; the rest of the city is well served with NGA broadband. The low level of NGA broadband availability in these areas could be due to the relatively high numbers of non-residential premises (which attract business-grade connectivity), and a relatively low population density.

Generally, the areas with a high percentage of ‘<2Mbit/s’ connections do not correspond to areas with low NGA broadband availability, so there does not seem to be a relationship between the two that has affected NGA broadband availability in Manchester.

It should be noted that broadband availability provides a snapshot in time, because it is expected that broadband roll-out will continue to evolve, provided that, for example:

- investment conditions remain attractive for broadband operators
- the demand stimulation intervention project in Manchester’s Super-Connected Cities programme progresses
- the Corridor project\(^{15}\) in the Manchester Oxford area goes ahead.

### 5.3 Impact analysis findings

There are 259 LSOAs in Manchester, and the broadband availability for each LSOA is derived using the Ofcom 2013 dataset. The impact analysis findings for the three measures of deprivation (income, education and crime) are provided in this section, using both methods (equal domain range and premises count).

#### 5.3.1 Income

**Equal domain range method**

Figure 5.4 below shows the distribution of income deprivation across Manchester using the equal domain range method.

\(\text{\footnotesize\(^{15}\) The project is still awaiting State-aid approval.}\)
It can be seen that a much lower proportion of LSOAs are in the most ‘income deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles. Geographically, the other three quartiles appear to be more evenly distributed.

Figure 5.5 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by income deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.

Figure 5.4: Distribution of income deprivation across Manchester using equal domain range method [Source: Analysys Mason, IMD, 2013]

Figure 5.5: Income deprivation analysis for Manchester using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Manchester there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 9.6 percentage points between the most and least ‘income deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases from the second to the third quartile, and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 18.1 percentage points between the most and least ‘income deprived’ quartiles)
  — NGA broadband availability decreases from the third to the fourth quartile despite the general trend.

**Equal premises count method**

Figure 5.6 below shows the distribution of income deprivation across Manchester using the equal premises count method.

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘income deprived’ areas of Manchester are scattered across the whole city.

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**Figure 5.6: Distribution of income deprivation across Manchester using equal premises count method [Source: Analysys Mason, IMD, 2013]**

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Figure 5.7 below provides quartile analysis by income deprivation using the equal premises count method. The right-hand vertical axis represents the percentage of premises considered in each quartile (which is the same for each quartile using the equal premises count method).
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Manchester there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 4.8 percentage points between the most and least ‘income deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases from the second to the third quartile, and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 6.2 percentage points between the most and least ‘income deprived’ quartiles)
  — however, there is a reduction of 3.8 percentage points in NGA broadband availability from the second to the fourth quartile, despite the general trend.

### 5.3.2 Education

*Equal domain range method*

Figure 5.8 below shows the distribution of education deprivation across Manchester using the equal domain range method.
It can also be observed that the most education deprived LSOAs (coloured in red, denoting the ‘0%–25%’ range on the map) are concentrated in two geographical areas. The remaining quartiles are more evenly distributed across Manchester.

Figure 5.9 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by education deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile.

Figure 5.9: Education deprivation analysis for Manchester using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of education deprivation decreases in Manchester there is:

- an inconsistent quartile-to-quartile decreasing trend in the percentage of ‘<2Mbit/s’ connections (a difference of 6.6 percentage points between the most and least ‘education deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases from the second to the third quartile, and

- an inconsistent quartile-to-quartile increasing trend in NGA broadband availability (a difference of 14.1 percentage points between the most and least ‘education deprived’ quartiles)
  — NGA broadband availability decreases from the third to the fourth quartile, despite the general trend.

*Equal premises count method*

Figure 5.10 below shows the distribution of education deprivation across Manchester using the equal premises count method.

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘education deprived’ areas in Manchester are concentrated in the north and south of the city.
Figure 5.11 below provides quartile analysis for education deprivation using the equal premises count method.

*Figure 5.11: Education deprivation analysis for Manchester using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]*

From the chart above, it can be observed that when the level of education deprivation decreases in Manchester there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 6.1 percentage points between the most and least ‘education deprived’ quartiles), and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 12.5 percentage points between the most and least ‘education deprived’ quartiles) — however, there is a reduction of 1.8 percentage points in NGA broadband availability from the second to the fourth quartile, despite the general trend.

### 5.3.3 Crime

*Equal domain range method*

Figure 5.12 below shows the distribution of crime rate levels across Manchester using the equal domain range method.
It can be seen that a much lower proportion of LSOAs are in the lowest crime rate level quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map) and the highest crime rate level quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles.

Figure 5.13 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by crime rate level. The right-hand vertical axis represents the percentage of premises considered in each quartile.

**Figure 5.13:** Crime deprivation analysis for Manchester using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of crime rate decreases in Manchester there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 6.0 percentage points between the highest and lowest crime rate level quartiles), and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 20.8 percentage points between the highest and lowest crime rate level quartiles)
  — NGA broadband availability decreases slightly from the third to the fourth quartile, despite the general trend.

*Equal premises count method*

Figure 5.14 below shows the distribution of crime rate levels across Manchester using the equal premises count method.

![Figure 5.14: Distribution of crime rate levels across Manchester using equal premises count method [Source: Analysys Mason, IMD, 2013]](image)

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it is noticeable that the areas with the highest crime rate levels in Manchester are predominantly in the north of the city.

Figure 5.15 below provides quartile analysis for the crime rate using the equal premises count method.
Figure 5.15: Crime deprivation analysis for Manchester using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]

From the chart above, it can be observed that when the level of crime rate decreases in Manchester there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.5 percentage points between the highest and lowest crime rate level quartiles)
  
  — the percentage of ‘<2Mbit/s’ connections increases from the first to the second quartile, and

- a **consistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 14.4 percentage points between the highest and lowest crime rate level quartiles).

5.3.4 Summary

As illustrated above, the two methods produce very similar results. However, since the equal domain range method highlights acute deprivation problems relative to the country as a whole, it is those results which are discussed in this section.

Key observations from the impact analysis of socio-economic factors on broadband availability for Manchester are summarised in Figure 5.16 below.
Impact analysis of socio-economic factors and broadband availability

Figure 5.16: Key observations on impact analysis for Manchester using equal domain range method [Source: Analysys Mason, 2013]

<table>
<thead>
<tr>
<th>Socio-economic factor</th>
<th>Key observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>• There is an inconsistent quartile-to-quartile decreasing trend in the percentage of ‘&lt;2Mbit/s’ connections when the level of income deprivation decreases</td>
</tr>
<tr>
<td></td>
<td>• There is an inconsistent quartile-to-quartile increasing trend in NGA broadband availability when the level of income deprivation decreases</td>
</tr>
<tr>
<td>Education</td>
<td>• There is an inconsistent quartile-to-quartile decreasing trend in the percentage of ‘&lt;2Mbit/s’ connections when the level of education deprivation decreases</td>
</tr>
<tr>
<td></td>
<td>• There is an inconsistent quartile-to-quartile increasing trend in NGA broadband availability when the level of education deprivation decreases</td>
</tr>
<tr>
<td>Crime</td>
<td>• There is a consistent quartile-to-quartile decreasing trend in the percentage of ‘&lt;2Mbit/s’ connections when the level of crime rate decreases</td>
</tr>
<tr>
<td></td>
<td>• There is an inconsistent quartile-to-quartile increasing trend in NGA broadband availability when the level of crime rate decreases</td>
</tr>
</tbody>
</table>

The analysis shows that there is a potential relationship between the investigated socio-economic factors and the percentage of ‘<2Mbit/s’ connections, because there is generally a decreasing trend in ‘<2Mbit/s’ connections when the level of deprivation decreases.

Moreover, the analysis shows that there is a potential relationship between the investigated socio-economic factors and NGA broadband availability, because there is generally an increasing trend in NGA broadband availability when the level of deprivation decreases.

It should be noted that attempts to investigate potential relationships between socio-economic factors and NGA broadband availability may be limited by the fact that Manchester already has high NGA broadband availability (86.3%). Also, it should be recognised that there are other factors that influence broadband roll-out; for example, it is well established that issues related to cost (e.g. premises density and line length) and take-up are significant considerations.
6 Impact analysis: Glasgow

6.1 City overview

The city boundary of Glasgow is defined as the Glasgow City Council geographical boundary as shown in Figure 6.1 below.

According to the 2011 census, Glasgow has a population of around 0.6 million and around 315 000 premises, of which 300 000 are residential premises.

6.2 Broadband availability

Using the Ofcom 2013 dataset, the percentage of ‘<2Mbit/s’ connections is estimated as 5.5% of all broadband connections across Glasgow and NGA broadband availability is estimated as 66.6% of all premises across Glasgow. Maps showing the broadband availability in Glasgow are provided in Figure 6.2 (‘<2Mbit/s’ connections) and Figure 6.3 (NGA broadband availability).
Areas with the highest percentage of ‘<2Mbit/s’ connections (worst areas), shown using red in Figure 6.2, are mostly in the north-east and south-west of the city; most of the city has a low percentage of ‘<2Mbit/s’ connections (between 0% and 5%).

Low levels of NGA broadband availability, shown using red in Figure 6.3, are scattered throughout the city, but the north and south-west regions are generally well served with NGA broadband.
Generally, the areas with a high percentage of ‘<2Mbit/s’ connections do not correspond to areas with low NGA broadband availability, so there does not seem to be a relationship between the two that has affected NGA broadband availability in Glasgow.

It should be noted that broadband availability provides a snapshot in time, because it is expected that broadband roll-out will continue to evolve, provided that, for example:

- investment conditions remain attractive for broadband operators
- intervention projects progress (such as the Future Cities Demonstrator programme and the Digital Glasgow initiative).

6.3 Impact analysis findings

There are 694 Data Zones within the Glasgow boundary, and the broadband availability for each Data Zone is derived using the Ofcom 2013 dataset. The impact analysis findings for the three measures of deprivation (income, education and crime) are provided in this section, using both methods (equal domain range and premises count).

6.3.1 Income

*Equal domain range method*

Figure 6.4 below shows the distribution of income deprivation across Glasgow using the equal domain range method.

![Figure 6.4: Distribution of income deprivation across Glasgow using equal domain range method [Source: Analysys Mason, IMD, 2013]](image-url)
It can be seen that a much lower proportion of Data Zones are in the most ‘income deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles. Geographically, the other three quartiles appear to be more evenly distributed.

Figure 6.5 below provides quartile analysis of the percentage of '<2Mbit/s' connections and NGA broadband availability (left-hand vertical axis) by income deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.

*Figure 6.5: Income deprivation analysis for Glasgow using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]*

From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Glasgow there is:

- no obvious quartile-to-quartile trend in the percentage of '<2Mbit/s' connections, and
- a consistent quartile-to-quartile increasing trend in NGA broadband availability (a difference of 47.4 percentage points between the most and least ‘income deprived’ quartiles).

*Equal premises count method*

Figure 6.6 below shows the distribution of income deprivation across Glasgow using the equal premises count method.
It can be observed that the Data Zones are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘income deprived’ areas of Glasgow are scattered across the whole city.

Figure 6.7 below provides quartile analysis by income deprivation using the equal premises count method. The right-hand vertical axis represents the percentage of premises considered in each quartile (which is the same for each quartile using the equal premises count method).
Impact analysis of socio-economic factors and broadband availability

From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Glasgow there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’
  connections (a difference of 0.7 percentage points between the most and least ‘income deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases from the third to the fourth quartile,
  and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 15.5 percentage points between the most and least ‘income deprived’ quartiles)
  — however, there is a reduction of 4.2 percentage points in NGA broadband availability between the second and third quartile.

6.3.2 Education

**Equal domain range method**

Figure 6.8 shows the distribution of education deprivation across Glasgow using the equal domain range method.

![Figure 6.8: Distribution of education deprivation across Glasgow using equal domain range method [Source: Analysys Mason, IMD, 2013]](image)

It can be seen that a much lower proportion of Data Zones are in the least ‘education deprived’ quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map) than in the other quartiles. The two most ‘education deprived’ quartiles encompass the majority of the city.
Figure 6.9 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by education deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile.

Figure 6.9: Education deprivation analysis for Glasgow using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]

From the chart above, it can be observed that when the level of education deprivation decreases in Glasgow there is:

- an inconsistent quartile-to-quartile decreasing trend in the percentage of ‘<2Mbit/s’ connections (a difference of 5.2 percentage points between the most and least ‘education deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases from the second to the third quartile, and

- a consistent quartile-to-quartile increasing trend in NGA broadband availability (a difference of 31.0 percentage points between the most and least ‘education deprived’ quartiles).

**Equal premises count method**

Figure 6.10 shows the distribution of education deprivation across Glasgow using the equal premises count method.
Impact analysis of socio-economic factors and broadband availability

It can be observed that the Data Zones are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘education deprived’ areas in Glasgow (shown in red) are distributed across the whole city.

Figure 6.11 below provides quartile analysis for education deprivation using the equal premises count method.

**Figure 6.11: Education deprivation analysis for Glasgow using equal premises count method** [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of education deprivation decreases (representing areas with higher levels of education) in Glasgow there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 1.0 percentage points between the most and least ‘education deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections increases from third to fourth quartile, and

- a **consistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 19.9 percentage points between the most and least ‘education deprived’ quartiles).

### 6.3.3 Crime

*Equal domain range method*

Figure 6.12 below shows the distribution of crime rate levels across Glasgow using the equal domain range method.

![Figure 6.12: Distribution of crime rate levels across Glasgow using equal domain range method](Image)

It can be seen that the proportion of Data Zones lying in the two highest crime rate level quartiles (coloured in red and yellow, denoting the ‘0%–25%’ and ‘25%–50%’ ranges on the map) are much lower than in the other two quartiles.

Figure 6.13 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis). The right-hand vertical axis represents the percentage of premises considered in each quartile.

Ref: 37110-226
From the chart above, it can be observed that when the level of crime rate decreases in Glasgow there is:

- an *inconsistent quartile-to-quartile increasing trend* in the percentage of ‘<2Mbit/s’ connections (a difference of 0.8 percentage points between the highest and lowest crime rate level quartiles)
  — the percentage of ‘<2Mbit/s’ connections decreases from the first to the second quartile, and

- a *consistent quartile-to-quartile increasing trend* in NGA broadband availability (a difference of 40.0 percentage points between the highest and lowest crime rate level quartiles).

**Equal premises count method**

Figure 6.14 below shows the distribution of crime rate levels using the equal premises count method.
It can be observed that the Data Zones are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it is noticeable that the areas of Glasgow with the highest crime rate levels are predominantly in the central areas of the city.

Figure 6.15 below provides quartile analysis for the crime rate using the equal premises count method.

![Crime deprivation analysis for Glasgow using equal premises count method](source: Analysys Mason, IMD, Ofcom, 2013)
From the chart above, it can be observed that when the level of crime rate decreases in Glasgow there is:

- an **inconsistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 0.3 percentage points between the highest and lowest crime rate level quartiles)
  — the percentage of ‘<2Mbit/s’ connections decreases from the first to the second quartile, and

- a **consistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 26.7 percentage points between the highest and lowest crime rate level quartiles).

### 6.3.4 Summary

As illustrated above, the two methods produce very similar results. However, since the equal domain range method highlights acute deprivation problems relative to the country as a whole, it is those results which are discussed in this section.

Key observations from the impact analysis of socio-economic factors on broadband availability for Glasgow are summarised in Figure 6.16 below.

*Figure 6.16: Key observations on impact analysis for Glasgow using equal domain range method [Source: Analysys Mason, 2013]*

<table>
<thead>
<tr>
<th>Socio-economic factor</th>
<th>Key observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• There is <strong>no obvious quartile-to-quartile trend</strong> in the percentage of ‘&lt;2Mbit/s’ connections when the level of income deprivation decreases</td>
</tr>
<tr>
<td></td>
<td>• There is a <strong>consistent quartile-to-quartile increasing trend</strong> in NGA broadband availability when the level of income deprivation decreases</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• There is an <strong>inconsistent quartile-to-quartile decreasing trend</strong> in the percentage of ‘&lt;2Mbit/s’ connections when the level of education deprivation decreases</td>
</tr>
<tr>
<td></td>
<td>• There is a <strong>consistent quartile-to-quartile increasing trend</strong> in NGA broadband availability when the level of education deprivation decreases</td>
</tr>
<tr>
<td>Crime</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• There is an <strong>inconsistent quartile-to-quartile increasing trend</strong> in the percentage of ‘&lt;2Mbit/s’ connections when the level of crime rate decreases</td>
</tr>
<tr>
<td></td>
<td>• There is a <strong>consistent quartile-to-quartile increasing trend</strong> in NGA broadband availability when the level of crime rate decreases</td>
</tr>
</tbody>
</table>

The analysis shows that there are differing relationships between the investigated education and crime domains and the percentage of ‘<2Mbit/s’ connections; while the percentage of ‘<2Mbit/s’ connections generally declines when the level of education deprivation decreases, it generally increases when the level of crime rate decreases. However, there is no obvious trend between income and the percentage of ‘<2Mbit/s’ connections.
In contrast, the analysis shows that the investigated socio-economic factors may possibly have influenced the roll-out of NGA broadband by fixed operators, because all domains show an increasing trend in NGA broadband availability when the level of deprivation decreases.

However, it should be recognised that there are other factors that influence broadband roll-out; in particular, it is well established that issues related to cost (e.g. premises density and line length) and take-up are significant considerations.

Out of the six cities investigated, Glasgow has the lowest NGA broadband availability (at 66.6%), significantly lower than for the other cities. This characteristic means that the findings for Glasgow are of particular importance for this study.
7 Impact analysis: Cardiff

7.1 City overview

The city boundary of Cardiff is defined as the Cardiff City Council geographical boundary, as shown in Figure 7.1 below.

According to the 2011 census, Cardiff has a population of around 341,000 and around 152,000 premises, of which 144,000 are residential premises.

7.2 Broadband availability

Using the Ofcom 2013 dataset, the percentage of ‘<2Mbit/s’ connections is estimated as 7.7% of all broadband connections across Cardiff, and NGA broadband availability is estimated as 90.9% of all premises across Cardiff. Maps showing broadband availability in Cardiff are provided in Figure 7.2 (‘<2Mbit/s’ connections) and Figure 7.3 (NGA broadband availability) below.
Areas with the highest percentage of ‘<2Mbit/s’ connections (worst areas), shown using red in Figure 7.2, are mostly in the east of Cardiff; most of the city has a low percentage of ‘<2Mbit/s’ connections (between 0% and 10%).

Areas with low availability of NGA broadband, shown in red in Figure 7.3, are concentrated in the west of Cardiff; the rest of the city is well served with NGA broadband.

In general, the areas with high levels of ‘<2Mbit/s’ connections do not correspond to areas with low NGA broadband availability, so there does not seem to be a relationship between the two measures that has affected NGA broadband availability in Cardiff.

It should be noted that this analysis of broadband availability provides a snapshot in time, because it is expected that broadband roll-out will continue to evolve, provided that, for example:

- investment conditions remain attractive for broadband operators, and
- the demand stimulation intervention project in Cardiff’s Super-Connected Cities programme progresses.
7.3 Impact analysis findings

There are 203 LSOAs in Cardiff, and the broadband availability for each LSOA is derived using the Ofcom 2013 dataset. The impact analysis findings for the three measures of deprivation (income, education and crime) are provided in this section, using both methods (equal domain range and premises count).

7.3.1 Income

*Equal domain range method*

Figure 7.4 below shows the distribution of income deprivation across Cardiff using the equal domain range method.

![Distribution of income deprivation across Cardiff using equal domain range method](image)

It can be seen that a much lower proportion of LSOAs are in the two most ‘income deprived’ quartiles (coloured in red and yellow, denoting the ‘0%–25%’ and ‘25%–50%’ ranges on the map) than in the other two quartiles. In contrast, the majority of LSOAs across the city belong to the least ‘income deprived’ quartile (shown in the darker green colour, denoting the ‘75%–100%’ range).

Figure 7.5 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by income deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Cardiff there is:

- a **consistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 4.5 percentage points between the most and least ‘income deprived’ quartiles), and

- an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 9.5 percentage points between the most and least ‘income deprived’ quartiles)
  — from Figure 7.3 earlier it can be seen that the west of Cardiff has very low NGA broadband availability, while Figure 7.4 shows that the west of the city contains some of the least ‘income deprived’ areas, which contributes to the surprisingly low NGA availability in the fourth quartile
  — in addition, NGA broadband availability increases from the second to the third quartile, despite the general trend.

**Equal premises count method**

Figure 7.6 below shows the distribution of income deprivation across Cardiff using the equal premises count method.
It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method.

Figure 7.7 below provides quartile analysis by income deprivation using the equal premises count method. The right-hand vertical axis represents the percentage of premises considered in each quartile (which is the same for each quartile using the equal premises count method).

From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Cardiff there is:
Impact analysis of socio-economic factors and broadband availability

- an inconsistent quartile-to-quartile increasing trend in the percentage of ‘<2Mbit/s’ connections (a difference of 3.7 percentage points between the most and least ‘income deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections decreases from the second to the third quartile, and

- an inconsistent quartile-to-quartile decreasing trend in NGA broadband availability (a difference of 10.0 percentage points between the most and least ‘income deprived’ quartiles)
  — from Figure 7.3 earlier, it can be seen that the west of Cardiff has very low NGA broadband availability, while Figure 7.6 shows that the west of the city contains some of the least ‘income deprived’ areas in Cardiff, which contributes to the surprisingly low NGA availability in the fourth quartile
  — in addition, NGA broadband availability increases from the second to the third quartile despite the general trend.

7.3.2 Education

Equal domain range method

Figure 7.8 shows the distribution of education deprivation across Cardiff using the equal domain range method.

It can be seen that the proportion of LSOAs in the most ‘education deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) is much lower than in the other quartiles. In contrast, the majority of Cardiff falls into the least ‘education deprived’ quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map).
Figure 7.9 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) for education deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and premises count methods of analysis.

Figure 7.9: Education deprivation analysis for Cardiff using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]

From the chart above, it can be observed that when the level of education deprivation decreases in Cardiff there is:

- a consistent quartile-to-quartile increasing trend in the percentage of ‘<2Mbit/s’ connections (a difference of 6.2 percentage points between the most and least ‘education deprived’ quartiles), and

- an inconsistent quartile-to-quartile decreasing trend in NGA broadband availability (a difference of 8.6 percentage points between the most and least ‘education deprived’ quartiles) — NGA broadband availability increases from the third to the fourth quartile, despite the general trend.
**Equal premises count method**

Figure 7.10 shows the distribution of education deprivation across Cardiff using the equal premises count method.

![Figure 7.10: Distribution of education deprivation across Cardiff using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]](image)

It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the most ‘education deprived’ areas of Cardiff are primarily in the eastern part of the city.

Figure 7.11 below provides quartile analysis for education deprivation using the equal premises count method.

![Figure 7.11: Education deprivation analysis for Cardiff using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]](image)
From the chart above, it can be observed that when the level of education deprivation decreases in Cardiff there is:

- an **inconsistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 1.8 percentage points between the most and least ‘education deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections decreases from the first to the second quartile, and

- **no obvious quartile-to-quartile trend** in NGA broadband availability.

### 7.3.3 Crime

**Equal domain range method**

Figure 7.12 below shows the distribution of crime rate levels across Cardiff using the equal domain range method.

![Figure 7.12: Distribution of crime rate levels across Cardiff using equal domain range method](source)

It can be seen that the proportion of LSOAs in the highest crime rate level quartile (coloured in red, denoting the ‘0%–25%’ range on the map) is much lower than the other quartiles. In contrast, the majority of areas in Cardiff lie in the lowest crime rate level quartile (shown in the darker green colour, denoting the ‘75%–100%’ range on the map).

Figure 7.13 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by crime rate level. The right-hand vertical axis represents the percentage of premises considered in each quartile.
Figure 7.13: Crime deprivation analysis for Cardiff using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]

From the chart above, it can be observed that when the level of crime rate decreases in Cardiff there is:

- a **consistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 4.0 percentage points between the highest and lowest crime rate level quartiles), and

- an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 9.7 percentage points between the highest and lowest crime rate level quartiles) — NGA broadband availability increases from the first to the second quartile, despite the general trend.

*Equal premises count method*

Figure 7.14 below shows the distribution of crime rate levels across Cardiff using the equal premises count method.
It can be observed that the LSOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it can be seen that the areas with the highest crime rate levels are in the east and south of the city.

Figure 7.15 below provides quartile analysis for the crime rate using the equal premises count method.

![Figure 7.14: Distribution of crime rate levels across Cardiff using equal premises count method](image)

![Figure 7.15: Crime deprivation analysis for Cardiff using equal premises count method](image)

Ref: 37110-226
From the chart above, it can be observed that when the level of crime rate decreases in Cardiff there is:

- an **inconsistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 4.3 percentage points between the highest and lowest crime rate level quartiles)
  - the percentage of ‘<2Mbit/s’ connections decreases from the second to the third quartile, and

- an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability (a difference of 12.0 percentage points between the highest and lowest crime rate level quartiles)
  - NGA broadband availability increases from the second to the third quartile, despite the general trend.

### 7.3.4 Summary

As illustrated above, the two methods produce very similar results. However, since the equal domain range method highlights acute deprivation problems relative to the country as a whole, it is those results which are discussed in this section.

Key observations from the impact analysis of socio-economic factors on broadband availability for Cardiff are summarised in Figure 7.16 below.

*Figure 7.16: Key observations on impact analysis for Cardiff using equal domain range method [Source: Analysys Mason, 2013]*

<table>
<thead>
<tr>
<th>Socio-economic factor</th>
<th>Key observations</th>
</tr>
</thead>
</table>
| Income               | - There is a **consistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections when the level of income deprivation decreases  
- There is an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability when the level of income deprivation decreases, which is surprising |
| Education            | - There is a **consistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections when the level of education deprivation decreases  
- There is an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability when the level of education deprivation decreases |
| Crime                | - There is a **consistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections when the level of crime rate decreases  
- There is an **inconsistent quartile-to-quartile decreasing trend** in NGA broadband availability when the level of crime rate decreases, which is surprising |

The analysis shows that there is a potential relationship between the investigated socio-economic factors and the percentage of ‘<2Mbit/s’ connections, because there is generally an **increasing trend in ‘<2Mbit/s’ connections** when the level of deprivation decreases.
Moreover, the analysis shows that there is a potential relationship between the investigated socio-economic factors and NGA broadband availability, because there is a decreasing trend in NGA broadband availability when the level of deprivation decreases. This is surprising, as it contradicts the trends observed for the other cities that have been investigated.

Because the western parts of Cardiff are rural areas, this could explain the low level of NGA broadband availability. In addition, these parts of Cardiff have some of the highest income and education levels in the whole of Wales, which helps to explain the surprising trends observed from the quartile analyses. This finding is further supported by the fact that other factors influence broadband roll-out; for example, it is well established that issues related to cost (e.g. premises density and line length) and take-up are significant considerations.

It should be noted that attempts to investigate potential relationships between socio-economic factors and NGA broadband availability may be limited by the fact that Cardiff already has a high level of NGA broadband availability (90.9%).
8 Impact analysis: Belfast

8.1 City overview

The city boundary of Belfast is defined as the Belfast City Council geographical boundary, as shown in Figure 8.1 below.

According to the 2011 census, Belfast has a population of around 269 000 and around 132 000 premises, of which 124 000 are residential premises.

8.2 Broadband availability

Using the Ofcom 2013 dataset, the percentage of ‘<2Mbit/s’ connections is estimated as 3.8% of all broadband connections across Belfast and NGA broadband availability is estimated as 98.1% of all premises across Belfast. Maps showing broadband availability in Belfast are provided in Figure 8.2 (‘<2Mbit/s’ connections) and Figure 8.3 (NGA broadband availability) below.
Areas with the highest percentage of ‘<2Mbit/s’ connections (*worst areas*), shown using red in Figure 8.2, are in the west of the city; there is a relatively low proportion of ‘<2Mbit/s’ connections in the remaining parts of the city.

As shown in Figure 8.3 below, Belfast is generally well served with NGA broadband. This is mainly due to the NGA broadband intervention project that was initiated in 2009 to upgrade around 1300 cabinets in approximately 170 exchange areas across Northern Ireland (including some located in Belfast).

Generally, the areas with a high level of ‘<2Mbit/s’ connections do not correspond to areas with low NGA broadband availability, so there does not seem to be a relationship between the two that has affected NGA broadband availability in Belfast.

It should be noted that broadband availability provides a snapshot in time, because it is expected that broadband roll-out will continue to evolve, provided that, for example:

- investment conditions remain attractive for broadband operators, and
- the demand stimulation intervention project in Belfast’s Super-Connected Cities programme progresses.

### 8.3 Impact analysis findings

There are 150 SOAs within the Belfast boundary, and the broadband availability for each SOA is derived using the Ofcom 2013 dataset. The impact analysis findings for the three measures of deprivation (income, education and crime) are provided in this section, using both methods (equal domain range and equal premises count).
8.3.1 Income

*Equal domain range method*

Figure 8.4 below shows the distribution of income deprivation across Belfast using the equal domain range method.

![Distribution of income deprivation across Belfast using equal domain range method](image)

It can be seen that a much lower proportion of SOAs are in the most ‘income deprived’ quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles, and these are concentrated in the centre of the city. Geographically, the other SOAs are more evenly distributed across the remaining quartiles.

Figure 8.5 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) by income deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile, to highlight the difference between the equal domain range and equal premises count methods of analysis.
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Belfast there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 4.6 percentage points between the most and least ‘income deprived’ quartiles), and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 3.4 percentage points between the most and least ‘income deprived’ quartiles)
  — NGA broadband availability decreases between the first and second quartile, despite the general trend.

**Equal premises count method**

Figure 8.6 below shows the distribution of income deprivation across Belfast using the equal premises count method. It can be observed that the SOAs are more evenly distributed across the quartiles than when using the equal domain range method.
Figure 8.6: Distribution of income deprivation across Belfast using equal premises count method [Source: Analysys Mason, IMD, 2013]

Figure 8.7 below provides quartile analysis by income deprivation using the equal premises count method. The right-hand vertical axis represents the percentage of premises considered in each quartile, which is the same for each quartile using the equal premises count method.

Figure 8.7: Income deprivation analysis for Belfast using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of income deprivation decreases (representing areas with higher income) in Belfast there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 3.7 percentage points between the most and least ‘income deprived’ quartiles), and

- a **consistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 3.8 percentage points between the most and least ‘income deprived’ quartiles).

### 8.3.2 Education

**Equal domain range method**

Figure 8.8 below shows the distribution of education deprivation across Belfast using the equal domain range method.

![Distribution of education deprivation across Belfast using equal domain range method](image)

It can be seen that the SOAs are evenly distributed across the four quartiles.

Figure 8.9 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis) for education deprivation. The right-hand vertical axis represents the percentage of premises considered in each quartile.
From the chart above, it can be observed that when the level of education deprivation decreases in Belfast there is:

- an **inconsistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 2.9 percentage points between the most and least ‘education deprived’ quartiles)
  — the percentage of ‘<2Mbit/s’ connections remains unchanged from the second to the third quartile, and

- a **consistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 8.1 percentage points between the most and least ‘education deprived’ quartiles).

**Equal premises count method**

Figure 8.10 shows the distribution of education deprivation across Belfast using the equal premises count method.
It can be observed that the SOAs are fairly evenly distributed across the four quartiles. In addition, it can be seen that the most ‘education deprived’ areas in Belfast are mostly in the north-east and central parts of the city.

Figure 8.11 below provides quartile analysis for education deprivation using the equal premises count method.

Figure 8.11: Education deprivation analysis for Belfast using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of education deprivation decreases (representing areas with higher levels of education) in Belfast there is:

- a **consistent quartile-to-quartile decreasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 3.0 percentage points between the most and least ‘education deprived’ quartiles), and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 6.3 percentage points between the most and least ‘education deprived’ quartiles)
  — NGA broadband availability decreases slightly between the third and fourth quartile, despite the general trend.

### 8.3.3 Crime

**Equal domain range method**

Figure 8.12 below shows the distribution of crime rate levels across Belfast using the equal domain range method.

![Figure 8.12: Distribution of crime rate levels across Belfast using equal domain range method](image)

It can be seen that a much lower proportion of SOAs are in the highest crime rate level quartile (coloured in red, denoting the ‘0%–25%’ range on the map) than in the other quartiles. SOAs are distributed more evenly across the other quartiles, and a slight majority lie in the lowest crime rate level quartile (shown in the darker green colour).
Figure 8.13 below provides quartile analysis of the percentage of ‘<2Mbit/s’ connections and NGA broadband availability (left-hand vertical axis). The right-hand vertical axis represents the percentage of premises considered in each quartile.

*Figure 8.13: Crime deprivation analysis for Belfast using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]*

From the chart above, it can be observed that when the level of crime rate decreases in Belfast there is:

- an **inconsistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 2.4 percentage points between the highest and lowest crime rate level quartiles)
  - ‘<2Mbit/s’ connections decrease by 1.0 percentage points between the third and fourth quartile, despite the general trend

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 2.2 percentage points between the highest and lowest crime rate level quartiles)
  - NGA broadband availability decreases by 2.9 percentage points between the first and second quartile, despite the general trend.

**Equal premises count method**

Figure 8.14 below shows the distribution of crime rate levels across Belfast using the equal premises count method.
It can be observed that the SOAs are more evenly distributed across the quartiles than when using the equal domain range method. In addition, it is noticeable that the areas with the highest crime rate levels are predominantly in the city centre.

Figure 8.15 below provides quartile analysis for the crime rate using the equal premises count method.

Figure 8.15: Crime deprivation analysis for Belfast using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]
From the chart above, it can be observed that when the level of crime decreases in Belfast there is:

- an **inconsistent quartile-to-quartile increasing trend** in the percentage of ‘<2Mbit/s’ connections (a difference of 1.2 percentage points between the highest and lowest crime rate level quartiles)
  - the level of ‘<2Mbit/s’ connections decreases by 1.5 percentage points between the third and fourth quartiles, despite the general trend, and

- an **inconsistent quartile-to-quartile increasing trend** in NGA broadband availability (a difference of 1.8 percentage points between the highest and lowest crime rate level quartiles)
  - NGA broadband availability decreases by 2.8 percentage points between the first and second quartiles, despite the general trend.

### 8.3.4 Summary

As illustrated above, the two methods produce very similar results. However, since the equal domain range method highlights acute deprivation problems relative to the country as a whole, it is those results which are discussed in this section.

Key observations from the impact analysis of socio-economic factors on broadband availability for Belfast are summarised in Figure 8.16 below.

*Figure 8.16: Key observations on impact analysis for Belfast using equal domain range method [Source: Analysys Mason, 2013]*

<table>
<thead>
<tr>
<th>Socio-economic factor</th>
<th>Key observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>There is a <strong>consistent quartile-to-quartile decreasing trend</strong> in the percentage of ‘&lt;2Mbit/s’ connections when the level of income deprivation decreases.</td>
</tr>
<tr>
<td></td>
<td>There is an <strong>inconsistent quartile-to-quartile increasing trend</strong> in NGA broadband availability when the level of income deprivation decreases.</td>
</tr>
<tr>
<td>Education</td>
<td>There is an <strong>inconsistent quartile-to-quartile decreasing trend</strong> in the percentage of ‘&lt;2Mbit/s’ connections when the level of education deprivation decreases.</td>
</tr>
<tr>
<td></td>
<td>There is a <strong>consistent quartile-to-quartile increasing trend</strong> in NGA broadband availability when the level of education deprivation decreases.</td>
</tr>
<tr>
<td>Crime</td>
<td>There is an <strong>inconsistent quartile-to-quartile increasing trend</strong> in the percentage of ‘&lt;2Mbit/s’ connections when the level of crime rate decreases.</td>
</tr>
<tr>
<td></td>
<td>There is an <strong>inconsistent quartile-to-quartile increasing trend</strong> in NGA broadband availability when the level of crime rate decreases.</td>
</tr>
</tbody>
</table>

The analysis shows that there is a potential relationship between income and education and the percentage of ‘<2Mbit/s’ connections, because there is generally a **decreasing trend in ‘<2Mbit/s’ connections** when the level of deprivation decreases. On the other hand, there is an **increasing trend in ‘<2Mbit/s’ connections’** when the level of crime rate decreases.
Moreover, the analysis shows that there is a potential relationship between the investigated socio-economic factors and NGA broadband availability, because there is generally an increasing trend in NGA broadband availability when the level of deprivation decreases.

It should be noted that attempts to investigate potential relationships between socio-economic factors and NGA broadband availability may be limited by the fact that Belfast already has high NGA broadband availability (98.1%). Also, it should be recognised that there are other factors which influence broadband roll-out; for example, it is well established that issues related to cost (e.g. premises density and line length) and take-up are significant considerations.
9 Comparison of key city data

This section compares key data from each of the six cities investigated for this study, and makes observations on key trends, differences and links between the various quartile analysis findings. The focus is on observing trends, rather than comparing the exact percentage figures across cities, because different nations use slightly different approaches when producing their deprivation parameters.

For the purposes of these comparisons and observing trends, findings based on the equal domain range method have been used; the resulting trends from both analysis methods are similar but the equal domain range method highlights better those areas with low broadband availability and acute deprivation.

9.1 Overview of broadband availability

Using Ofcom’s 2013 broadband availability dataset, the percentage of ‘<2Mbit/s’ connections and NGA broadband availability have been derived for each city studied, as summarised in Figure 9.1.

<table>
<thead>
<tr>
<th>City</th>
<th>‘&lt;2Mbit/s’ connections</th>
<th>NGA broadband availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>3.7%</td>
<td>88.4%</td>
</tr>
<tr>
<td>Birmingham</td>
<td>4.2%</td>
<td>91.3%</td>
</tr>
<tr>
<td>Manchester</td>
<td>5.5%</td>
<td>86.3%</td>
</tr>
<tr>
<td>Glasgow</td>
<td>5.5%</td>
<td>66.6%</td>
</tr>
<tr>
<td>Cardiff</td>
<td>7.7%</td>
<td>90.9%</td>
</tr>
<tr>
<td>Belfast</td>
<td>3.8%</td>
<td>98.1%</td>
</tr>
</tbody>
</table>

London has the lowest percentage of ‘<2Mbit/s’ broadband connections, whilst Manchester, Glasgow and Cardiff have the highest percentage of ‘<2Mbit/s’ broadband connections (greater than 5%).

With the exception of Glasgow, all cities have NGA broadband availability of more than 86%. Belfast has exceptionally high availability of NGA broadband (98.1%), which most likely reflects the effect of the broadband intervention project initiated by the Department of Enterprise, Trade and Investment in 2009. The relatively low level of NGA broadband availability in Glasgow makes the city particularly suitable for investigating the potential relationships between socio-economic factors and broadband availability.

It should be noted that broadband availability is continually evolving, based on a range of factors (such as network operator plans, demand registration and public sector intervention projects), and so the results presented here represent a ‘snapshot’ in time.

More detailed comparisons of the percentage of ‘<2Mbit/s’ broadband connections and NGA broadband availability across the six cities are provided in Sections 9.2 and 9.3 respectively.
9.2 ‘<2Mbit/s’ broadband connections

9.2.1 Income deprivation

Figure 9.2 compares outputs from the income deprivation quartile analysis, indicating the percentage of ‘<2Mbit/s’ broadband connections for each city.

*Figure 9.2: Comparison of income deprivation quartile analysis of ‘<2Mbit/s’ connections [Source: Analysys Mason, IMD, Ofcom, 2013]*

In general, all cities except Cardiff and Glasgow show a **decreasing trend** in the percentage of ‘<2Mbit/s’ broadband connections when the level of income deprivation decreases. However, Manchester exhibits an inconsistent decreasing trend (with an increase between the second and third quartile), which may be because other factors (such as existing take-up and premises density) have an overriding effect in some areas.

Cardiff could be considered as an exception, in that although the western parts of the city have a very low level of income deprivation they do have a relatively high percentage of ‘<2Mbit/s’ broadband connections. This may be explained by particular factors associated with the high rurality of these parts of the city (e.g. long line length and potential geographical challenges).

Glasgow does not show any obvious trend in the percentage of ‘<2Mbit/s’ broadband connections when the level of income deprivation decreases.
9.2.2 Education deprivation

Figure 9.3 compares the outputs from the education deprivation quartile analysis, indicating the percentage of ‘<2Mbit/s’ broadband connections for each city.

*Figure 9.3: Comparison of education deprivation quartile analysis of ‘<2Mbit/s’ connections [Source: Analysys Mason, IMD, Ofcom, 2013]*

In general, all cities except Cardiff show a decreasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the level of education deprivation decreases. However, the trends for Glasgow, London and Manchester are inconsistent, which may be explained by the fact that other factors (such as existing take-up and premises density) have an overriding effect in some areas.

Again, Cardiff could be considered as an exception, in that although the western parts of Cardiff have a very low level of education deprivation they do have a relatively high percentage of ‘<2Mbit/s’ broadband connections. This may be due to the reasons discussed in Section 9.2.1 above.
9.2.3 Crime deprivation

Figure 9.4 compares the outputs from the crime deprivation quartile analysis, indicating the percentage of ‘<2Mbit/s’ broadband connections for each city.

*Figure 9.4: Comparison of crime deprivation quartile analysis of ‘<2Mbit/s’ connections [Source: Analysys Mason, IMD, Ofcom, 2013]*

Four of the cities show an increasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the crime rate decreases. Birmingham and Manchester generally show a decreasing trend in the percentage of ‘<2Mbit/s’ broadband connections when the crime rate decreases.

9.2.4 Summary

Figure 9.5 below summarises the trends that have been identified, to help highlight the impact that the investigated socio-economic factors have on the percentage of ‘<2Mbit/s’ broadband connections. In this table, declining trends are shown in green (on the basis that the ‘best’ areas have the lowest percentage of ‘<2Mbit/s’ broadband connections), while increasing trends are shown in red (on the basis that the ‘worst’ areas have the highest percentage of ‘<2Mbit/s’ broadband connections).
Figure 9.5: Summary of impact of socio-economic factors on the percentage of ‘<2Mbit/s’ connections
[Source: Analysys Mason, IMD, Ofcom, 2013]

<table>
<thead>
<tr>
<th>Trend in socio-economic indicators</th>
<th>Trend in ‘&lt;2Mbit/s’ broadband connections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glasgow</td>
</tr>
<tr>
<td>When level of income deprivation decreases</td>
<td></td>
</tr>
<tr>
<td>When level of education deprivation decreases</td>
<td></td>
</tr>
<tr>
<td>When level of crime decreases</td>
<td></td>
</tr>
</tbody>
</table>

Key: ▲ Consistent increasing trend  ▼ Inconsistent increasing trend  No obvious trend
■ Inconsistent decreasing trend  ▼ Consistent decreasing trend

From the above table, it can be observed that across the investigated cities:

- there is generally a **decreasing trend** in the percentage of ‘<2Mbit/s’ broadband connections when the level of **income deprivation decreases**

- there is generally a **decreasing trend** in the percentage of ‘<2Mbit/s’ broadband connections when the level of **education deprivation decreases**

- there is generally an **increasing trend** in the percentage of ‘<2Mbit/s’ broadband connections when the **crime rate decreases**.
9.3 NGA broadband availability

9.3.1 Income deprivation

Figure 9.6 below compares the outputs from the income deprivation quartile analysis of NGA broadband availability for each city.

*Figure 9.6: Comparison of income deprivation quartile analysis of NGA broadband availability [Source: Analysys Mason, IMD, Ofcom, 2013]*

In general, all cities except Cardiff and Birmingham show an increasing trend in NGA broadband availability when the level of income deprivation decreases. However, the London, Manchester and Belfast trends are inconsistent, which may be explained by the fact that other issues (such as existing take-up and premises density) have an overriding effect in some areas. Birmingham shows no obvious trend, while Cardiff exhibits a decreasing trend in NGA broadband availability when the level of income deprivation decreases.

Again, Cardiff could be treated as an exception, in that although the western parts of Cardiff have very low levels of income deprivation, the availability of NGA broadband is limited. This may be due to the reasons discussed in Section 9.2.1 above. It is noted that the Welsh Government’s Superfast Cymru rural broadband project will address the NGA broadband availability issues faced by the western parts of Cardiff.
9.3.2 Education deprivation

Figure 9.7 compares the outputs from the education deprivation quartile analysis of NGA broadband availability for each city.

Figure 9.7: Comparison of education deprivation quartile analysis of NGA broadband availability [Source: Analysys Mason, IMD, Ofcom, 2013]

In general, there is no obvious trend in NGA broadband availability when the level of education deprivation decreases. This could mean that other factors have an overriding effect in some areas (such as existing take-up and premises density).

The city centres of Birmingham and London have very low levels of NGA broadband availability, but their levels of education deprivation are relatively high. It should be noted that the city centres and their neighbouring areas have a high number of non-residential premises, which mostly require business-class connectivity (e.g. leased lines) rather than broadband, and have relatively low population densities. These factors could have discouraged network operators from rolling out NGA broadband in these city centres.

The level of education deprivation is very low in the western parts of Cardiff, but NGA broadband availability is also low. This may be due to the reasons discussed in Section 9.2.1 above.
9.3.3 Crime deprivation

Figure 9.8 compares outputs from the crime deprivation quartile analysis of NGA broadband availability for each city.

*Figure 9.8: Comparison of crime deprivation quartile analysis of NGA broadband availability [Source: Analysys Mason, IMD, Ofcom, 2013]*

In general, all cities except Cardiff and London show an increasing trend in NGA broadband availability when the level of crime rate decreases. Some of the trends are inconsistent, which may be due to other factors (such as existing take-up and premises density) having an overriding effect in some areas.

The city centre of London has very low NGA broadband availability, most likely due to the large number of non-residential premises and the low population density. This possibly explains the sharp drop in NGA broadband availability between the third and fourth quartiles in the chart above.

9.3.4 Summary

Figure 9.9 below summarises the trends that have been identified, to help highlight the impact that the investigated socio-economic factors have on NGA broadband availability. In this table, increasing trends are shown in green (on the basis that the ‘best’ areas have higher NGA broadband availability), while declining trends are shown in red (on the basis that the ‘worst’ areas have lower NGA broadband availability).
Figure 9.9: Impact of socio-economic factors on NGA broadband availability [Source: Analysys Mason, IMD, Ofcom, 2013]

<table>
<thead>
<tr>
<th>Trend in socio-economic indicators</th>
<th>Trend in NGA broadband availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasgow</td>
<td>Birm'ham</td>
</tr>
<tr>
<td>When level of income deprivation decreases</td>
<td><img src="image" alt="Consistent increasing trend" /></td>
</tr>
<tr>
<td>When level of education deprivation decreases</td>
<td><img src="image" alt="Consistent increasing trend" /></td>
</tr>
<tr>
<td>When level of crime decreases</td>
<td><img src="image" alt="Consistent increasing trend" /></td>
</tr>
</tbody>
</table>

Key: ![Consistent increasing trend](image) ![Inconsistent increasing trend](image) ![No obvious trend](image) ![Inconsistent decreasing trend](image) ![Consistent decreasing trend](image)

From the above table, it can be observed that across the investigated cities (particularly if Cardiff is considered as an exception, for the reasons outlined in Section 9.2.1):

- there is generally an **increasing trend** in NGA broadband availability when the level of income deprivation decreases
- there is no overall obvious trend in NGA broadband availability when the level of education deprivation decreases
- there is generally an **increasing trend** in NGA broadband availability when the crime rate decreases.

### 9.4 Conclusions and recommendations

#### 9.4.1 Conclusions

The analysis has demonstrated **marked relationships between socio-economic deprivation factors and broadband availability**.

It has also highlighted that individual cities have localities where there are acute deprivation issues combined with low NGA broadband availability.

It is also seen that not all cities follow the general trends, but this reflects the fact that particular districts of each city should be considered as having unique and sometimes highly localised characteristics that have an impact on broadband availability.
9.4.2 Recommendations

Therefore, policy makers seeking to identify ways to stimulate economic growth and investment should investigate broadband-related issues, such as lack of NGA availability and problems with ‘<2Mbits’ connections, using data analysis comparable to that undertaken in this report. An assessment of the links between broadband and socio-economic factors such as income, education and crime can improve understanding of the problems faced by individual UK cities, which are sometimes complex.

The data analysis in this report has only been completed for six cities. Any policy development at the national level would ideally be based on analysis of a wider sample of cities, conducted at a suitably granular level; analysis at postcode level would be necessary as a minimum, but analysis at street level should also be considered. Alternatively, any cities that wish to develop local broadband policies and delivery plans should consider the implications of this analysis as part of the policy development process. In addition, the data analysis could include other factors which may influence broadband availability, such as unemployment, house prices and existing broadband take-up.
Annex A  Methodology

The full methodology used for the impact analysis of socio-economic factors on broadband roll-out strategies involves eight steps, as explained below.

1. Gather Index of Multiple Deprivation (IMD) domain data (income, education and crime) from each nation government’s website. It should be noted that IMD and its deprivation scores are calculated differently by each nation, and so it is not possible for this study to make a quantitative comparison between cities in different nations.

2. Derive the percentage of ‘<2Mbit/s’ connections and NGA broadband availability, based on Ofcom’s 2013 broadband availability dataset for each LSOA in England and Wales, Data Zone in Scotland and SOA in Northern Ireland.

<table>
<thead>
<tr>
<th>City</th>
<th>‘&lt;2Mbit/s’ connections</th>
<th>NGA broadband availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td>3.7%</td>
<td>88.4%</td>
</tr>
<tr>
<td>Birmingham</td>
<td>4.2%</td>
<td>91.3%</td>
</tr>
<tr>
<td>Manchester</td>
<td>5.5%</td>
<td>86.3%</td>
</tr>
<tr>
<td>Glasgow</td>
<td>5.5%</td>
<td>66.6%</td>
</tr>
<tr>
<td>Cardiff</td>
<td>7.7%</td>
<td>90.9%</td>
</tr>
<tr>
<td>Belfast</td>
<td>3.8%</td>
<td>98.1%</td>
</tr>
</tbody>
</table>

Figure A.1: Broadband availability for UK cities in 2013 [Source: Analysys Mason / Ofcom, 2013]

3. Produce ‘<2Mbit/s’ connections and NGA broadband availability maps for each city under study using a geographical information system (GIS) tool.

— Five equal ranges have been used on all maps showing NGA broadband availability in the cities studied:

a. 0%–20%
b. 20%–40%
c. 40%–60%
d. 60%–80%
e. 80%–100%

An example of an NGA broadband availability map is provided below.
Impact analysis of socio-economic factors and broadband availability

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Figure A.2: NGA broadband availability in Glasgow [Source: Analysys Mason, Ofcom, 2013]

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Five ranges have also been used for ‘<2Mbit/s’ connections, but these ranges are unequal because the distribution of ‘<2Mbit/s’ connections per region (LSOA / SOA / Data Zone) generally lies between 0% and 10%, and majority of the remaining regions have between 10% and 30% ‘<2Mbit/s’ connections. Accordingly, the following unequal ranges have been used for all cities:

a. 0%–5%

b. 5%–10%

c. 10%–20%

d. 20%–30%

e. 30%–100%

An example of a ‘<2Mbit/s’ broadband connections map is provided below.
4. Produce IMD domain maps for each city using both of the methods described below:

   a. **Equal domain range** – the domain range (that is, the difference between the maximum and minimum values of each IMD domain score) for each city is divided into four equal IMD domain score ranges (quartiles). This means that each quartile may represent a different percentage of premises on the bar chart due to the different socio-economic profile of Data Zones / LSOAs / SOAs across a city.

   b. **Equal premises count** – the total number of premises for each city is divided into four equal premises count ranges (quartiles). Note that each quartile contains approximately 25% of premises because the sum of premises in a quartile is based on the number of premises in each Data Zone / LSOA / SOA (ranked by a particular socio-economic factor), which is not always exactly 25%.

5. Calculate the percentage of ‘<2Mbit/s’ connections and NGA availability for each quartile and each method described above. The broadband availability figures are derived as weighted average values using premises-level data.

6. Carry out quartile analysis of deprivation scores and broadband availability in the form of bar charts for each method described above. An example of a quartile analysis chart for each method is shown below.
Figure A.4: Income deprivation results for Glasgow using equal domain range method [Source: Analysys Mason, IMD, Ofcom, 2013]

Figure A.5: Income deprivation results for Glasgow using equal premises count method [Source: Analysys Mason, IMD, Ofcom, 2013]

7. Produce geographical maps based on quartile ranges using both methods. This allows, for example, the most deprived and least deprived areas to be quickly identified geographically using the map colour range. Examples of geographical maps produced using the two methods are shown below.
8. Draw key observations from each quartile analysis chart and geographical map for each city. In some cases, known local factors such as public intervention are used to suggest potential explanations for the analysis shown in the quartile analysis charts and/or geographical maps.