Buffering Britain
RESEARCH NOTE

Consumer Welfare Losses from Mobile Network Congestion

London and the UK: a WTP-based estimate

Research note | May 2026

£150–260m
London speed losses
per year

£490–785m
UK speed losses
per year

1.31×
London speed penalty
from congestion

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Executive Summary

This note estimates the annual consumer welfare losses caused by mobile network congestion in London and across the UK. The analysis transfers willingness-to-pay parameters from a discrete choice experiment, calibrates the speed degradation using Opensignal and Ofcom performance data, and aggregates losses across mobile data users.

£150–260m
London speed losses
preferred speed-only range, annual

£490–785m
UK speed losses
preferred speed-only range, annual

£200–340m
London with latency
if illustrative latency estimates hold

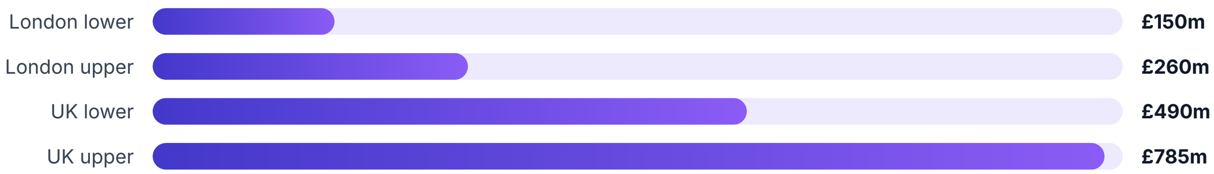
Policy implication

The welfare losses are attributed to insufficient mobile network capacity during peak hours. Reducing congestion through cell-site densification – especially small cells and additional macro sites – strengthens the case for streamlining planning approvals for mobile infrastructure.

Method at a glance

1. **WTP parameters**
2. **Observed speeds**
3. **Congestion profile**
4. **Income scaling**
5. **Aggregate welfare**

Preferred annual speed-only welfare losses



The latency component is deliberately separated because published time-of-day latency data for UK mobile networks is unavailable. The speed component is the main empirically calibrated estimate; latency and reliability losses are additional and require primary data collection to narrow uncertainty.

Contents

Abstract

We estimate the annual consumer welfare losses from mobile network congestion in London and the UK using willingness-to-pay (WTP) parameters from a discrete choice experiment on internet access preferences. Adapting speed valuations from Czajkowski et al. (2024) and calibrating congestion levels using Opensignal/Ofcom crowdsourced performance data, we find annual welfare losses from speed degradation of approximately **£150–260 million for London** and **£490–785 million for the UK** as a whole, after adjusting for hypothetical bias in stated preference estimates.

The UK-wide estimate uses actual national operator speeds from Opensignal (January 2026) but relies on assumed congestion severity outside London, where no published time-of-day speed data exists at the sub-national level. Latency degradation during congestion plausibly adds losses of a similar order of magnitude, but no published time-of-day latency data exists for UK mobile networks; the note presents illustrative latency welfare calculations that await empirical calibration. These losses are attributable to insufficient cell-site density, which is substantially constrained by local planning decisions on mast approvals.

1. Model

1.1 Source of WTP estimates

We draw on Czajkowski, Zawadzki, Bernatek & Sobolewski (2024), “Consumer preferences for internet access: Fixed versus mobile, and the role of 5G,” WNE Working Paper 15/2024 (451), forthcoming in *Telecommunications Policy*. The study estimates a random-parameters logit model in WTP space using data from a discrete choice experiment (DCE) with 5,204 Polish respondents conducted in 2018.

Respondents chose between home fixed (HF), home mobile (HM), and mobile (MO) internet alternatives characterised by speed, latency, data transfer limits, and monthly cost. The WTP-space specification yields coefficients that are directly interpretable as marginal willingness to pay in monetary units.

$$V_{nj} = -\alpha_n(Cost_j - \Sigma_k \beta_{nk} \cdot x_{jk})$$

where $\alpha_n > 0$ is the individual-specific cost sensitivity parameter and β_{nk} are WTP parameters distributed across the population.

1.2 Key parameters

Table 1 reports the estimated WTP-space coefficients from Table 2 of Czajkowski et al. (2024). All coefficients are in units of 100 PLN/month.

Variable	Distribution	Mean	SD	Units
$\log(Speed_{Gb/s})$	Normal	0.1503	0.1330	100 PLN/mo
$-\log(Latency_{100ms})$	Log-Normal	0.0273	0.0312	100 PLN/mo
$\log(Transfer_{100GB})$	Log-Normal	0.0623	0.0359	100 PLN/mo
$-Cost_{100PLN}$	–	1.5729	1.2133	scale

Note: All means significant at the 1% level. For log-normally distributed parameters, the reported mean and SD are the parameters of the underlying normal distribution.

1.3 Welfare formulae

For a representative consumer experiencing a speed improvement from s_0 to s_1 (Mbps):

$$\Delta W_{speed} = 15.03 \times \ln(s_1/s_0) \text{ PLN/month}$$

For a latency reduction from ℓ_0 to ℓ_1 (ms):

$$\Delta W_{latency} = 2.73 \times \ln(\ell_0/\ell_1) \text{ PLN/month}$$

These are in 2018 Polish prices. Both expressions follow directly from the log specifications of the utility function.

1.4 Income scaling to London

We adjust for differences in income between the Polish survey sample and London residents using GDP per capita at purchasing power parity. Poland 2018 GDP/cap PPP is $33,891, UK 2018 GDP/cap PPP is $49,210, and London's GVA premium is approximately 1.70.

$$\rho = (49{,}210 / 33{,}891) \times 1.70 = 2.47$$

We convert from PLN to GBP via the PPP rate and UK PPP exchange rate:

$$\Delta W^{London}_{GBP} = \Delta W_{PLN} \times (0.69 / 1.70) \times \rho^{\eta}$$

where $\eta \in [0.5, 1.0]$ is the income elasticity of WTP. The central case uses $\eta = 1$.

1.5 Population

London population is approximately 9.0 million. UK smartphone penetration is 95% (Ofcom, 2024). Assuming 90% of smartphone owners use cellular data regularly gives:

$$N = 9{,}000{,}000 \times 0.95 \times 0.90 = 7{,}695{,}000 \text{ mobile data users}$$

This excludes the approximately 1 million daily inbound commuters who also use London's mobile networks.

2. Data

2.1 London mobile network performance: speed

We use operator-level data from Opensignal reports, London-specific where available, and UK market share estimates.

Operator	4G (Mbps)	5G (Mbps)	Market share	Adjusted share
EE	54.5	117	28%	33.3%
Vodafone	53.8	139	21%	25.0%
Three	46.2	223	9%	10.7%
O2	35.5	81	26%	30.9%
Weighted avg.	**47.6**	**122.7**		

Table 2: London mobile data speeds by operator.

With approximately 20% of London user time on 5G connections, the blended uncongested speed is:

$$\bar{s}_{uncong} = 0.80 \times 47.6 + 0.20 \times 122.7 = 62.6 \text{ Mbps}$$

Opensignal time-of-day analysis for London shows 4G speeds ranging from 17.5 Mbps at the 5pm peak to 38.3 Mbps at 3am off-peak – a factor of 2.2×. More recent UK-wide data shows operator speeds dropping 15–30% from daily peak during noon–midnight. We model three usage periods:

Period	Share of usage	Speed as % of uncongested
Off-peak (midnight–8am)	15%	95%
Shoulder (8am–noon, 9pm–midnight)	35%	85%
Peak (noon–9pm)	50%	65%
Usage-weighted average		**76.5%**

Table 3: Usage-time weighting of congestion.

$$\bar{s}_{actual} = 62.6 \times 0.765 = 47.9 \text{ Mbps}$$

The effective speed multiplier from eliminating congestion is 62.6/47.9 = **1.31×**.

2.2 Latency

Operator-level latency data from Ofcom Mobile Matters 2024 is available as all-day averages. These reported averages include off-peak periods when latency is at its best. During peak-hour congestion, latency rises substantially due to queuing delays at congested cells.

Operator	5G latency (ms)	4G latency (ms)
Three	16.3	~21
EE	~18	18.3
Vodafone	~20	23.7
O2	21.4	~23
Approx. weighted avg.	**~19**	**~21**

Table 4: UK mobile latency by operator and technology.

Important caveat: Opensignal does not publish time-of-day latency breakdowns for the UK. The log specification means we are extrapolating the WTP curve into a region of the latency distribution that neither DCE presented to respondents.

We use the same usage-period structure as for speed. Latency is more sensitive to congestion than throughput: when a cell is at capacity, packets queue and latency spikes.

Period	Share of usage	Latency (ms)
Off-peak	15%	16
Shoulder	35%	22
Peak	50%	35
Usage-weighted average		**27.6 ms**

Table 5: Latency congestion assumptions.

The counterfactual uncongested latency is $\bar{\ell}_{\text{uncong}} = 18$ms, blended across 4G and 5G under uncongested conditions.

3. Results

3.1 Speed welfare gains

Using the speed formula and income adjustment:

$$\Delta W_{\text{speed per user}} = 15.03 \times \ln(62.6/47.9) \times (0.69/1.70) \times \rho^{\eta} = 15.03 \times 0.268 \times 0.406 \times \rho^{\eta}$$

Income elasticity η	None	30% discount	50% discount
η = 0.5	£237m	£166m	£119m
η = 0.75	£297m	£208m	£149m
η = 1.0	£372m	£261m	£186m

Table 6: Annual aggregate welfare gains from eliminating speed congestion.

3.2 Latency welfare gains: illustrative

Important caveat: No published data exists on time-of-day mobile latency variation for London or any UK city. Ofcom and Opensignal report all-day average latency by operator but do not disaggregate by hour. The congestion scenarios below are calibrated from engineering priors rather than empirical measurement.

$$\Delta W_{\text{latency per user}} = 2.73 \times \ln(27.6/18) \times (0.69/1.70) \times \rho^{\eta} = 2.73 \times 0.428 \times 0.406 \times \rho^{\eta}$$

We also compute a low-congestion scenario with peak-hour latency of 28ms, giving a usage-weighted average of 23.5ms and ln(23.5/18) = 0.267.

η	Central: no adj.	Central: 50% disc.	Low: no adj.	Low: 50% disc.
η = 0.5	£69m	£34m	£43m	£21m
η = 0.75	£86m	£43m	£54m	£27m
η = 1.0	£108m	£54m	£67m	£34m

Table 7: Annual aggregate welfare gains from eliminating latency congestion.

3.3 Combined welfare losses

Table 8 presents combined speed and latency welfare losses. The speed component is grounded in empirical congestion data; the latency component is illustrative pending primary data collection.

Estimate	None	30% discount	50% discount
Speed only: η = 0.5	£237m	£166m	£119m
Speed only: η = 0.75	£297m	£208m	£149m
Speed only: η = 1.0	£372m	£261m	£186m
Speed + latency: η = 0.5	£306m	£214m	£153m
Speed + latency: η = 0.75	£383m	£268m	£192m
Speed + latency: η = 1.0	£480m	£336m	£240m

Table 8: Combined annual welfare losses: speed + latency (£m/year).

Preferred London estimate

The preferred estimate for speed losses alone uses η = 0.75–1.0 with a 30–50% hypothetical bias discount, yielding approximately **£150–260 million per year**. If the illustrative latency estimates prove approximately correct once empirical data is available, total welfare losses could reach **£200–340 million per year**.

As a sanity check, Analysys Mason (2012) estimated total UK mobile consumer surplus at £24–28 billion. The speed-only estimate implies that London peak-hour congestion destroys approximately 0.5–1.0% of national mobile consumer surplus – concentrated in the city with the highest user density and thus the most to gain from capacity expansion.

4. Extension to the UK

4.1 UK-wide speed data

We extend the London-specific analysis to the UK as a whole using national operator speed data from Opensignal's Mobile Network Experience Report, January 2026, based on crowdsourced data from October–December 2025.

Operator	Blended 4G+5G (Mbps)	5G only (Mbps)	Market share
EE	53.2	92.2	33%
Three	51.0	187.0	11%
Vodafone	37.5	130.9	25%
O2	32.8	89.9	31%
Weighted avg.	**42.7**	**111.6**	

Table 9: UK national download speeds by operator.

The weighted UK national all-day average speed is 42.7 Mbps, substantially below London's constructed estimate. We back out the rest-of-UK average speed as a residual:

$$\bar{s}_{rest} = (\bar{s}_{UK} - \omega_L \cdot \bar{s}_{London}) / (1 - \omega_L) = 38.6 \text{ Mbps}$$

4.2 Rest-of-UK congestion

London congestion severity is grounded in Opensignal's published time-of-day speed charts, which show peak-hour speeds at approximately 65% of uncongested levels. For the rest of the UK, no comparable time-of-day data is published at the sub-national level. We assume milder congestion outside London based on three points:

- Tutela (2020) measured Three UK's peak-hour slowdown at 36% nationally, but Three is the most congested operator; other operators showed 15–25% drops.
- Rural and suburban areas – which comprise the majority of UK geography though not necessarily of usage – experience minimal congestion.
- Other large cities such as Manchester, Birmingham and Leeds face moderate congestion but less acute than London's uniquely dense user concentration.

The central assumption is that rest-of-UK peak-hour speeds are 80% of uncongested, compared with 65% in London. This yields a usage-weighted speed fraction of 0.868, compared with 0.765 in London.

4.3 Income scaling

For the rest of the UK, we apply the UK-wide income ratio without the London GVA premium.

$$\rho_{UK} = 49{,}210 / 33{,}891 = 1.45$$

$$N_{rest} = 58{,}000{,}000 \times 0.95 \times 0.90 = 49{,}590{,}000$$

4.4 UK-wide results

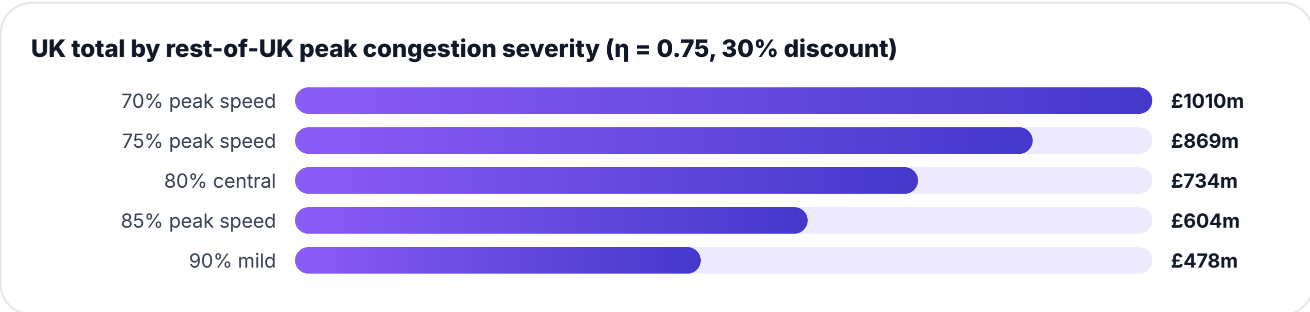
η	London: 30%	Rest UK: 30%	UK total: 30%	London: 50%	Rest UK: 50%	UK total: 50%
0.50	£166m	£435m	£601m	£119m	£311m	£429m
0.75	£208m	£478m	£686m	£149m	£341m	£490m
1.00	£261m	£524m	£785m	£186m	£375m	£561m

Table 10: Annual speed welfare losses from mobile congestion (£m/year).

The preferred UK-wide estimate uses η = 0.75–1.0 with a 30–50% hypothetical bias discount, yielding approximately **£490–785 million per year** for speed losses across the UK. London accounts for roughly one-third despite containing only 13% of UK mobile users, reflecting worse congestion and higher incomes.

Per-user welfare losses at η = 0.75 with a 30% bias discount are £27/year (£2.25/month) in London and £10/year (£0.80/month) in the rest of the UK.

Sensitivity to rest-of-UK congestion



Peak speed as % of uncongested	Rest-of-UK (£m)	UK total (£m)
70% (near-London severity)	£802m	£1,010m
75%	£661m	£869m
80% (central assumption)	£526m	£734m
85%	£395m	£604m
90% (mild congestion)	£270m	£478m

Table 11: Sensitivity of UK total to rest-of-UK congestion.

Data provenance

1. **Measured:** UK national operator speeds; 5G connection shares; London operator speeds.
2. **Derived:** Rest-of-UK all-day speed, backed out from national average minus London contribution.
3. **Assumed:** Rest-of-UK congestion severity. This is the key judgment call, informed by national peak-hour data and the logic that rural and suburban areas are less congested.

5. Assumptions and Caveats

1. Stated preference and hypothetical bias. All WTP estimates derive from hypothetical choices, not actual purchase behaviour. The meta-analytic literature finds systematic hypothetical bias in stated preference studies. Murphy et al. (2005) report a median hypothetical-to-actual ratio of 1.35 for choice-based mechanisms, while Schmidt & Bijmolt (2020) find an average bias of 21% for consumer goods, with larger bias for higher-valued products.

Haghani et al. (2021) find that while hypothetical bias affects opt-in rates and total WTP levels, marginal rates of substitution between attributes show substantially less bias. Since this welfare calculation depends on WTP-space coefficients – marginal valuations of speed and latency – the relevant bias may be closer to 20–30% than to 50%. The results therefore report both a 30% discount and a 50% discount.

2. Preference transferability. The DCE was conducted on Polish consumers in 2018. London consumers face different outside options, have different usage patterns and different baseline expectations. Income scaling adjusts for level differences but not structural differences in demand.

3. Latency congestion calibration. Opensignal publishes time-of-day speed data but not time-of-day latency data for London or any UK city. Peak-hour latency assumptions are engineering conjectures, not empirical measurements. The speed congestion ratios are better grounded in published London data. The latency welfare estimates should accordingly be treated as illustrative.

4. Logarithmic specification. The log-log functional form captures diminishing marginal returns to speed and latency improvements: the value of going from 10 to 20 Mbps exceeds the value of going from 100 to 110 Mbps. However, extrapolating from the Polish sample's median mobile speed to London's current speeds requires the estimated curvature to be stable out of sample.

5. Income elasticity. WTP is assumed to scale with income raised to η. Setting $\eta = 1$ assumes proportional scaling; $\eta = 0.5$ assumes WTP is concave in income. For telecom quality improvements specifically, no consensus exists.

6. Omitted dimensions.

- **Reliability:** Network connection failures and timeouts are not captured by speed or latency averages.
- **Business users and commuters:** Approximately 1 million daily commuters into central London and business/enterprise mobile users are excluded.
- **Data limits:** The model includes a separate WTP coefficient for data transfer limits, which may be relevant if congestion also affects effective data consumption.

7. Second-order effects. The model assumes that behavioural responses to speed are approximately zero. In reality, congestion may cause substitution toward WiFi or avoidance of data-intensive activities during peak hours, meaning the welfare loss is partially internalised as reduced usage.

8. No UK-specific WTP research. Frontier Economics / LS telcom (2022), in a report commissioned by DCMS, stated that since the 2012 study there has been no new willingness-to-pay research, making it difficult to estimate consumer surplus reliably. The speed-only congestion-loss estimate of £150–260 million represents approximately 0.5–1.0% of Analysys Mason's 2012 estimate of total mobile consumer surplus – a plausible magnitude for the cost of peak-hour speed degradation in one city. This estimate fills a gap identified by the UK government's own commissioned research, but should not substitute for primary UK research.

6. Policy Implication

The welfare losses documented here are attributable to insufficient mobile network capacity during peak hours. The engineering solution – cell-site densification through small cells and additional macro sites – is well understood. The binding constraint is planning: local authority approval rates for mobile mast installations vary substantially across London boroughs and councils nationwide, with conservation area designations, amenity objections, and prior approval processes creating significant delays and refusals.

Planning reform case

If planning liberalisation could reduce peak-hour congestion to near-uncongested levels, the resulting welfare gains from speed improvements alone – on the order of **£150–260 million per year in London** and **£490–785 million per year UK-wide** – provide a strong case for streamlining the approvals process for mobile infrastructure, particularly small cells deployed on existing street furniture. Latency and reliability improvements, once empirically quantified, would add substantially to this figure.

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About Buffering Britain

Buffering Britain is a campaign to improve mobile signal. It exists to stand up for people and businesses fed up with dropped connections and phantom bars, and to get digital infrastructure delivered faster and more beautifully.