Modelling Public Transport Service Outages

ITRN 2026

NTA
Údarás Náisiúnta Iompair
National Transport Authority

Introduction/Motivation

Public transport services (especially rail based) are vulnerable to service interruptions due to factors such as:

- Extreme Weather
- Bridge Strikes
- Social disturbances – protests, riots etc.
- Technical issues

Rail services are often high capacity with little rerouting potential

Examples

Sources: Irish Sun and RTE

Examples

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Introduction/Motivation

While there may be expert knowledge or experience regarding the best mitigation measures for a single line (i.e. buses from Bray to Dun Laoghaire when DART services are down), this issue becomes more complex when looking at networks

Public transport is provided by a number of operators who may be impacted

Requirement to understand the rerouting impacts

Can the existing models assist mitigation measures due to their granular representation of public transport services and the assignment algorithms – use an existing resource?

Case study approach to test the idea

NTA Regional Modelling System

Suite of 4-stage strategic transport models comprised of:

Trip Generation – Mode and Destination Choice – Network Assignment

Trips are generated based on land use in Stage 1

Trips are assigned to destinations and modes in Stages 2 & 3

Trips are assigned to routes (walk, cycle, and driving) and services (public transport) in Stage 4

Succeeding stages can be rerun – you can run Stage 4 without rerunning Stage 1 etc, but not proceeding stages – you can't run Stage 1 without rerunning Stages 2-4

NTA Regional Modelling System

The last stage of these is network assignment models (stage 4)– this study is specifically focused upon the public transport network assignment model(s)

This model includes the full public transport network and timetables in the state using generalised cost to represent transport impedance

Network assignment is undertaken in Cube Voyager – an industry standard logit routing assignment algorithm

These models were developed for transport network planning and appraisal purposes, and have gone through an extensive calibration/validation and checking processes ensuring realistic responses to changes in the transport environment

NTA Regional Modelling System

The assignment model uses mode and destination “demand matrices” created in Stage 1-3 as their inputs

These matrices tell us where people wish to travel and by which mode (but not yet by which service)

Trips are then assigned to public transport services based on the network represented in the model

If you change this network (by removing a service etc,), you change the assignment (but you can keep the “demand matrices” constant – people still want to go to zone A from zone B by public transport)

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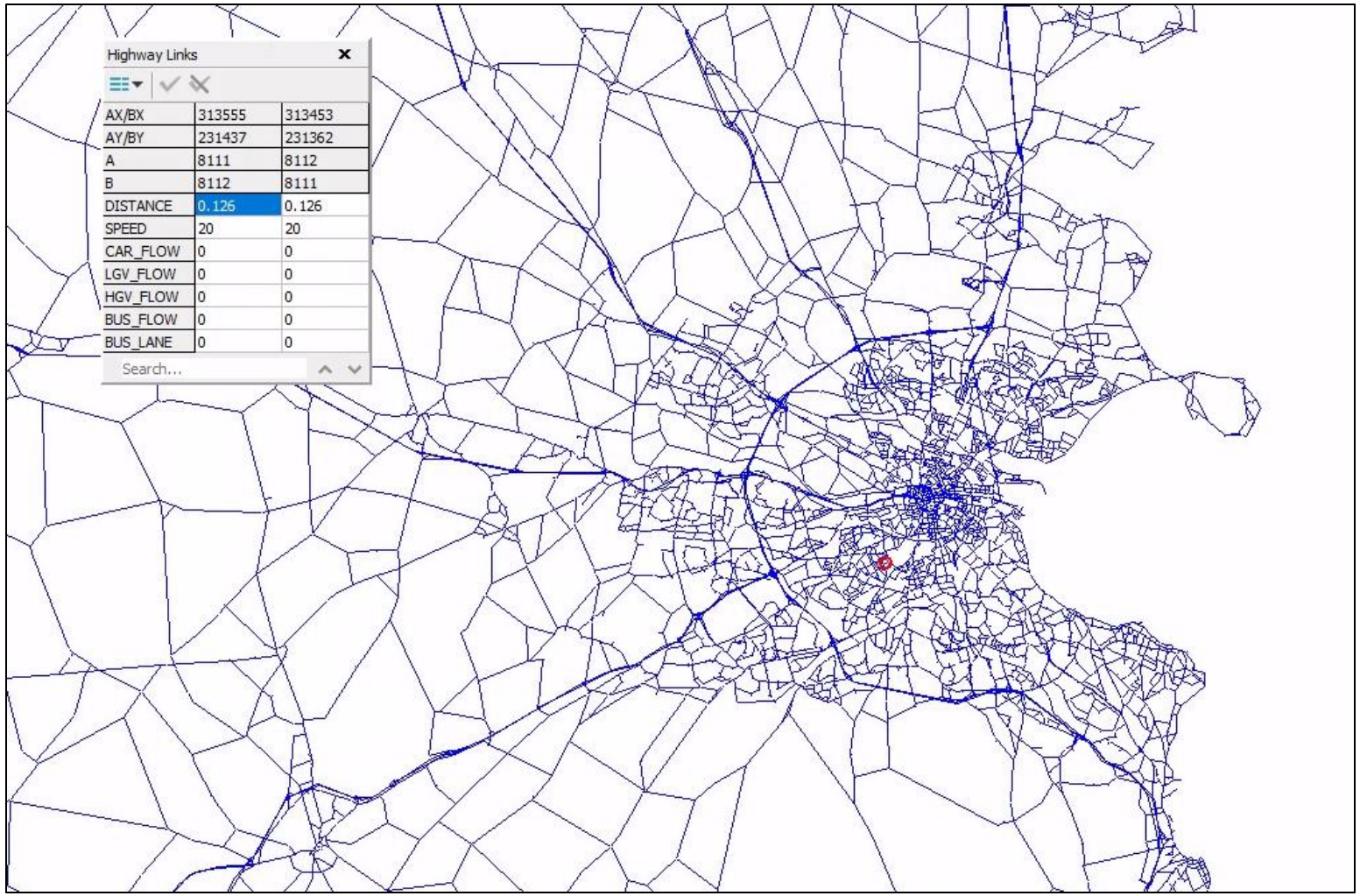

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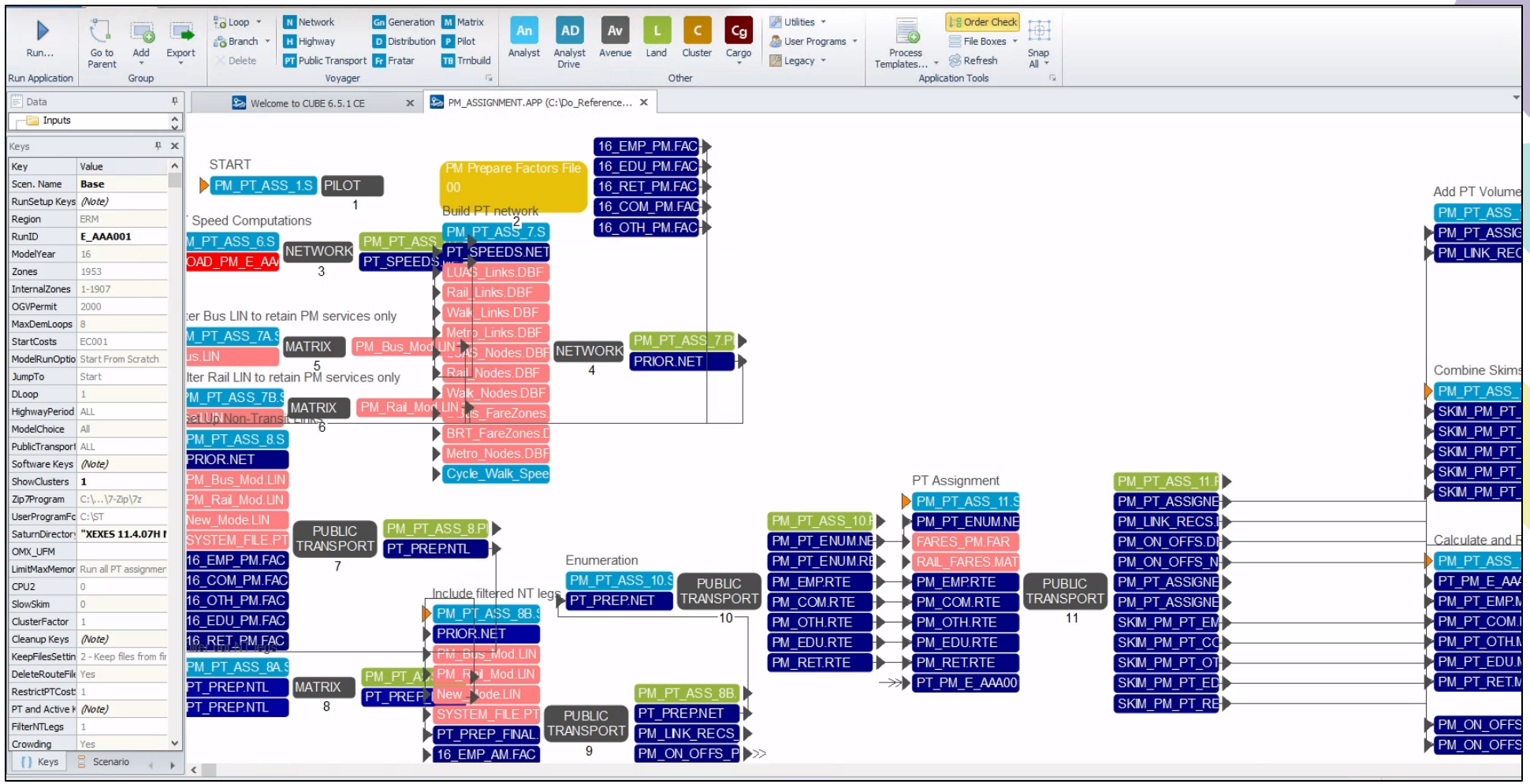

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Case Studies

Two hypothetical case studies are tested in the work:

1. Failure of the Metrolink system

2. Failure of the entire Dublin Luas Network

Both case studies are set in 2043 to allow a comparison with the NTA's reference case model runs and where a large rail network is in place

The case studies assume a PM failure (4pm-7pm), meaning no changes to trip distribution or mode – people need to get home and don't have access to a car/bike

Trips will still travel by public transport, but need to find new routes

Caveats/Assumptions

The model was not primarily designed for this purpose so there are some limitations to be noted:

1. Services can go above capacity – though this is actually useful in this case to see new link demand

2. In reality a proportion of trips will just walk longer distances than usual – the model will assign to PT

3. This type of modelling works best for rail (heavy and light), where services can't be diverted as easily – buses may be more flexible

Overall, this is still a bit of a work in progress

Results

Short overview of the results of the initial tests

Note: each tests took ~ 4 hours to complete – this is not a real time response tool

Both tests display the multi-service nature of rerouting when a major rail line/network is no longer available

Results shown via passenger flow difference plots

Metrolink Test

Based on the assumed full curtailment of Metrolink services in the PM Peak we see:

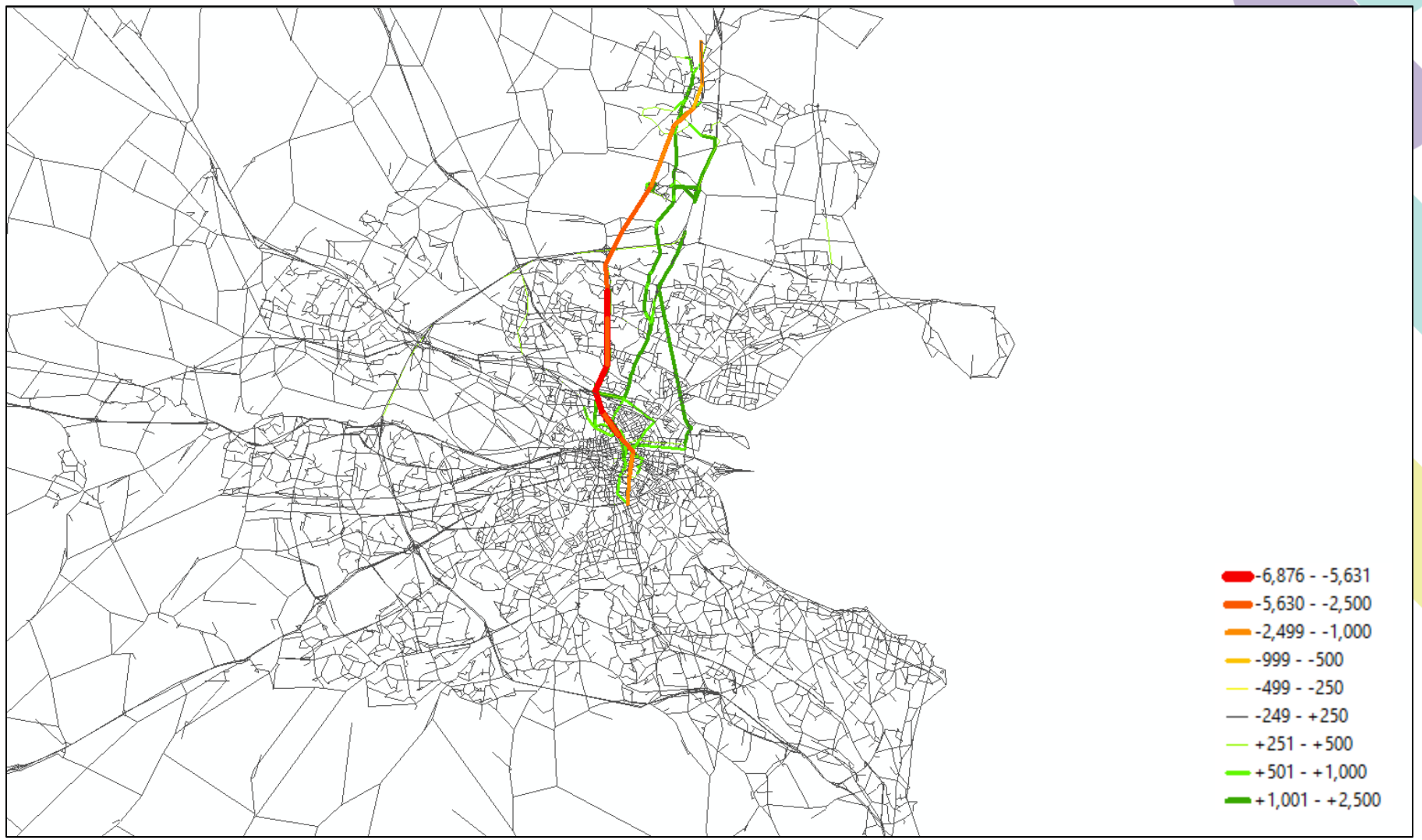
Clear reduction in demand on the metro – shows the service is unavailable

Increases in demand in northern inner city and buses to Ballymun & Glasnevin bus routes

Separate and distinct demand increases on M1 and Port Tunnel services from Dublin city centre to Swords and Dublin Airport

Small increase on Luas Finglas also observed

Metrolink Test



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Metrolink Test

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Luas Test

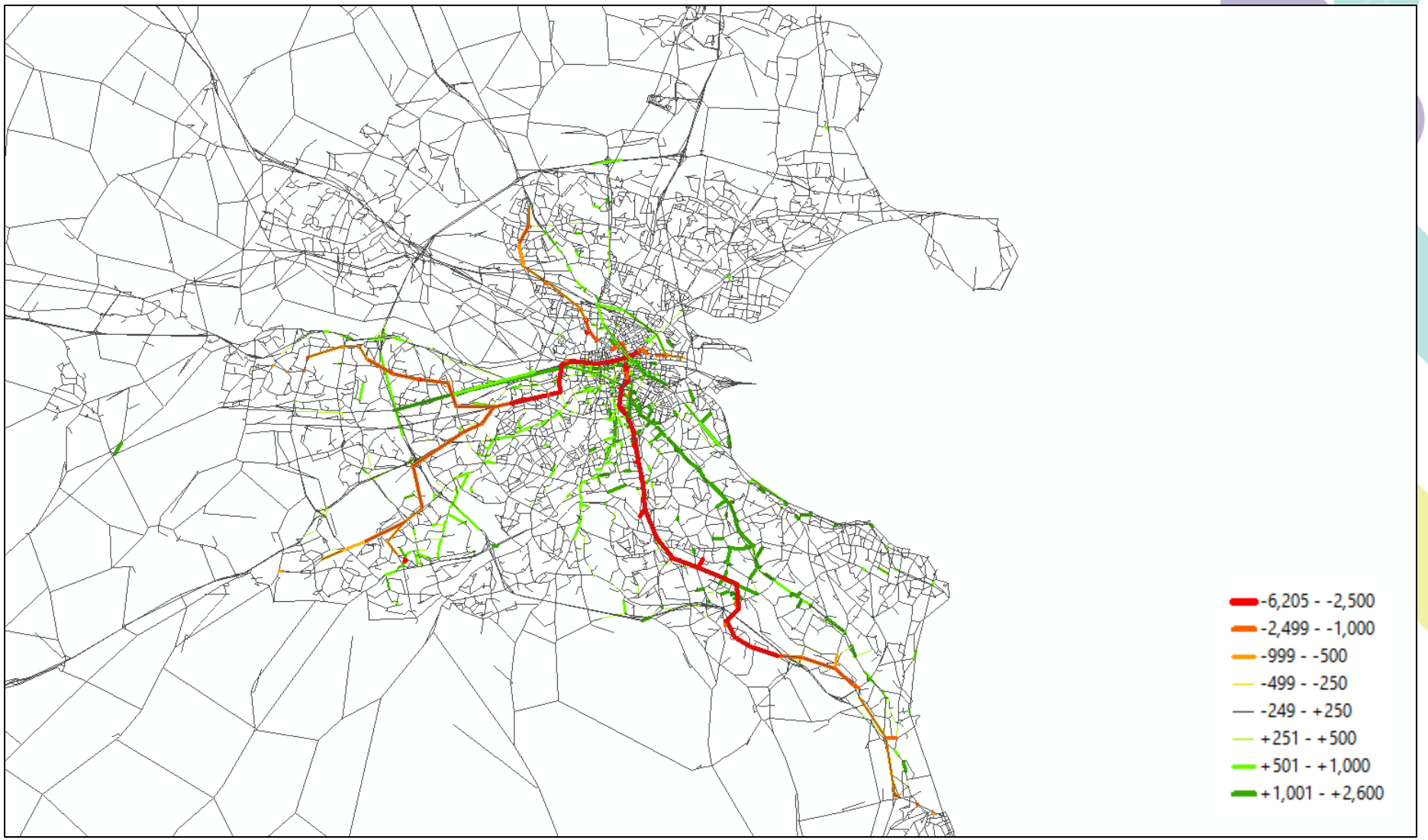
Based on the assumed full curtailment of Luas services – multi-line curtailment

Large increase in demand on old-N11 bus routes, as well a more modest increase in Rathmines buses and DART services (as Luas 2043 serves Bray)

Heuston Rail services also see a large increase in demand with minor increases to Tallaght buses as service to Lucan/Tallaght is lost

More modest increase is seen on north side rail and buses to compensate for Luas Finglas

Luas Test



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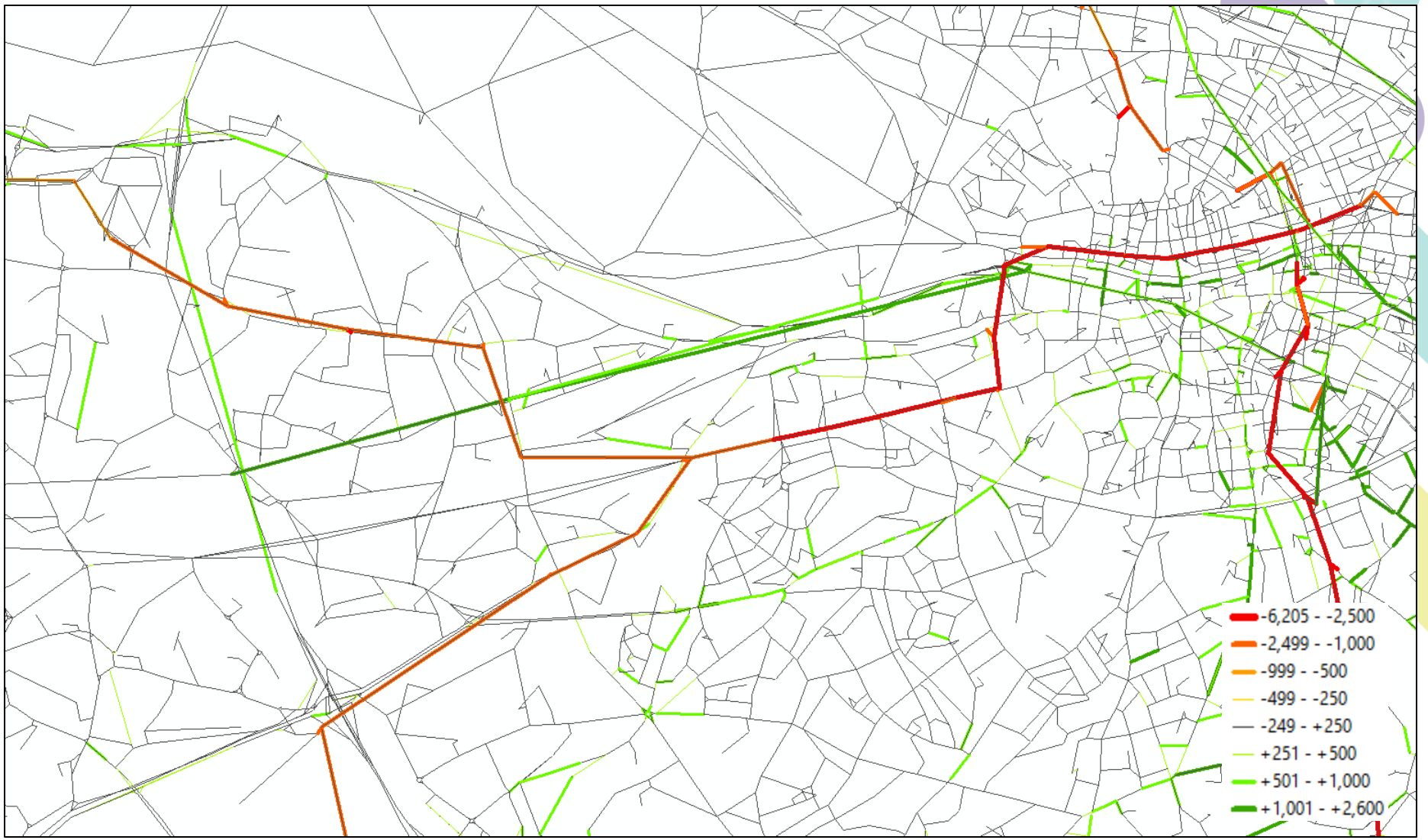
Luas Test



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Summary

Initial modelling shows sensible redistribution patterns

The Metrolink test demonstrated the different areas of demand to be served Ballymun/Glasnevin vs. Swords/Airport and suggests different mitigation services could be used (buses via the tunnel etc.)

The Luas test highlights the redistribution across a wider range of services – it is worth considering the impacts on other operators (Bus providers, Irish rail etc.)

Overall, it suggests the existing tools/public assets have some capacity to provide insights into the impact of disruptions to high-capacity rail links

Summary

Thank you – Any Questions/Comments?