5G Enhanced Smart Junctions

Transport for Greater Manchester

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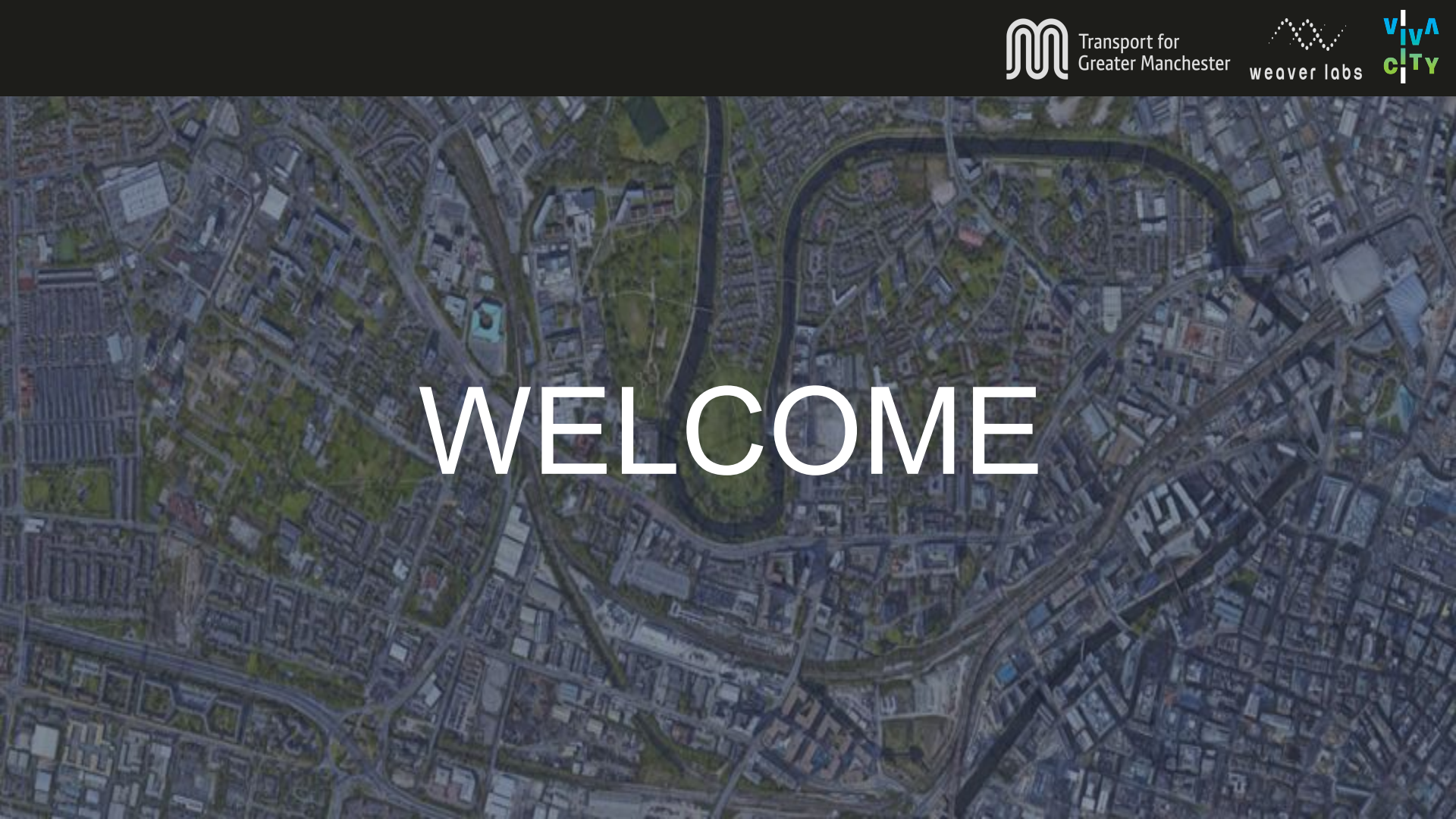
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WELCOME

Project Team

Alexander Yeomans

VivaCity
Technical Project Manager

Maria Lema

Weaver Labs
Co-Founder

Sam Li

TfGM
Senior Innovation Officer

Hannah Tune

TfGM
ITS Development Manager

Agenda

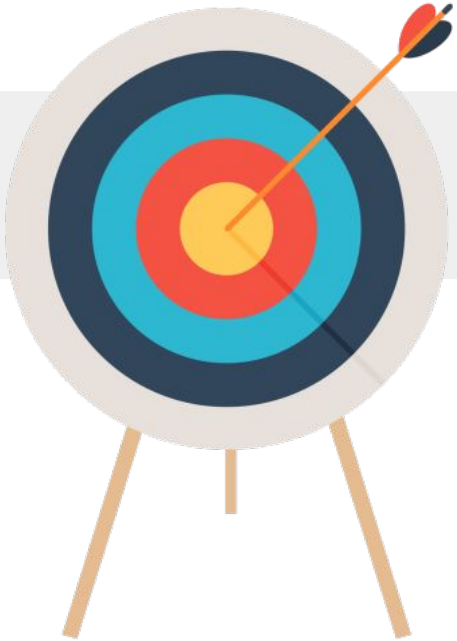
11:45am	DCMS Opening Remarks and Project Team Presentation
12:40pm	Break
12:45pm	Lessons Learned Panel Session
1:30pm	Lunch
2:45pm	Transport Panel Session
3:30pm	Break
3:45pm	Future of Networks Panel Session
4:30pm	Closing Remarks
5:00pm	Drinks Reception

DCMS Opening Remarks

So,

What Have We **Been Up To…**

Aims and Objectives



Smart City Use Case

Demonstrate benefits to real time traffic control and cost benefits of rolling out SJ 5G

Vendor Diversification

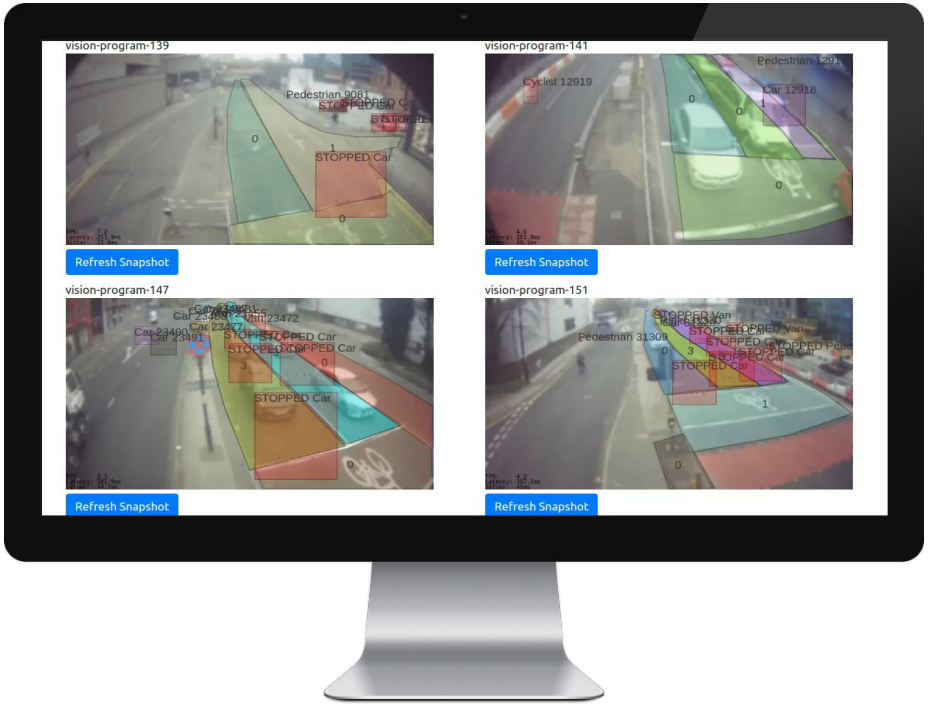
Deliver a 5G private O-RAN network that seamlessly integrates between assets whilst prioritising cyber-security

Business Model

Demonstrate long term commercial benefits using a NaaS commercial model with a local authority owned network

Smart City Use Case

VivaCity's Smart Junctions - an AI based traffic signal optimisation



Helping cities to modernise their traffic signal control

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Coordinated Control Initially

Congestion Focus
Automation unusual

Coordinated Control Today

Air Quality
Sustainable Travel
Worse Congestion
Same tech as 1990s

Multi-Modal Optimisation

Efficiently and Effectively

Enact new city wide policies

Better Optimisation

Local, regional and city-wide scale

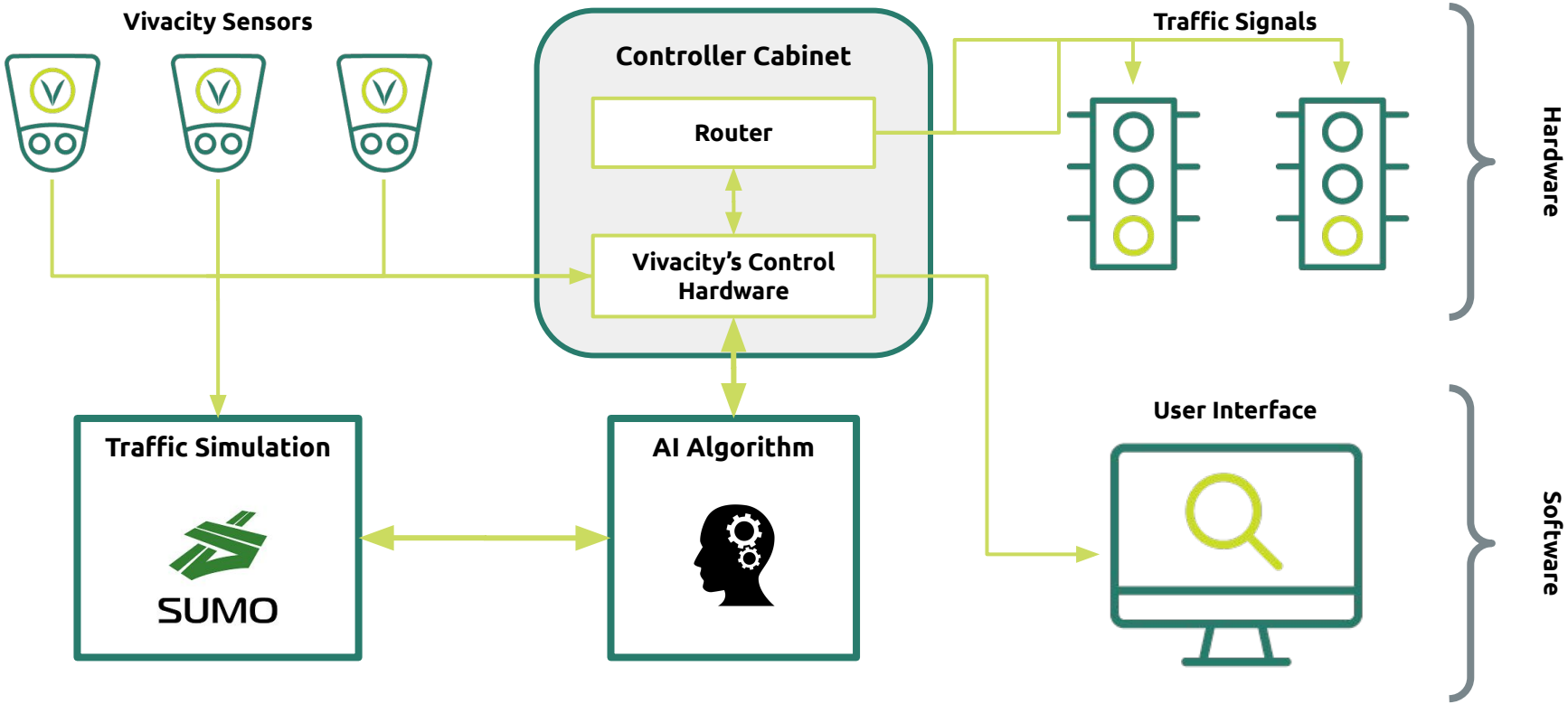
Dynamic and Adaptive

To quick changes in demand

Automated Calibration

Modern interface

Our award-winning Smart Junction solution that uses cutting edge reinforcement learning



Vivacity Junction Monitoring Dashboard

Smart Junctions Corridor

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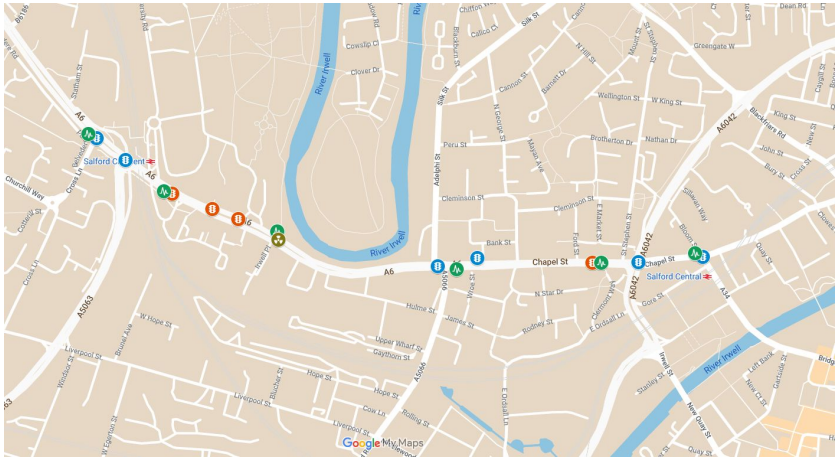
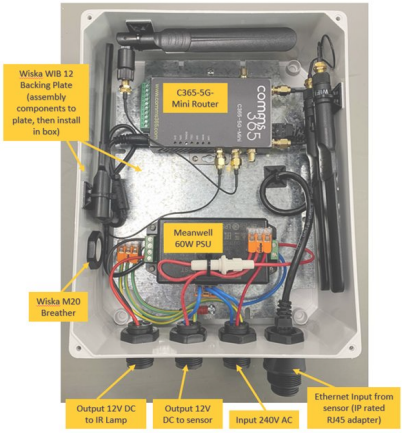
9 Junctions in corridor

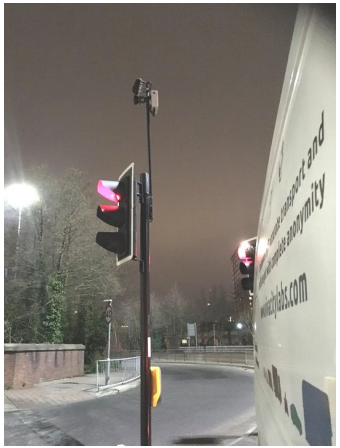
57 sensors installed

49 External 5G routers Retrofit

Development for Integrated 5G Vivacity Sensor







Smart Junction Connectivity

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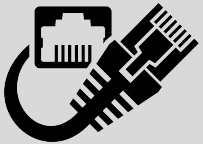
Real Time Deployments require a low latency, reliable connection



Wired Ethernet

Prohibitive cost
Non-scalable

Wireless 4G

Unreliable, High latency - particularly with high congestion

What we have seen in deployments already

	Transport for Greater Manchester	Peterborough City Council	Cambridgeshire County Council
Connectivity Method	**Wireless 5G/4G + Ethernet** For sensors, both wireless and wired for cabinet hardware	**Wireless 4G** For both sensors and cabinet hardware	**Wireless 4G** For both sensors and cabinet hardware
Connectivity Effects	**Network congested locations next to train stations and University buildings** **High Latency peaks**	**Connectivity blind spots** **Un-reliable** **High latency peaks**	**Network congested location** **Connectivity blind spots** **High Latency peaks**

This is where a private 5G network comes in

Reliable & Replicable

Minimal network downtime in an architecture that is easily replicable

Low Latency

No latency peaks during congested periods and allowing real time data

Scalable & Cost Effective

Cost benefits particularly at scale when connecting a corridor or region

5G Technical


Bringing the **open decentralised model** for Smart Cities to allow **diversity** in the telecoms supply chain.

The Challenge: a cheap network that can grow fast

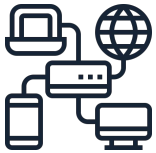
Requirements

- **Strictly separated from the consumer traffic** to make sure it's available when the sensors need it
- **Affordable and easy to maintain** to reduce the gap of adoption by using a commoditised approach to connectivity
- **Leverage the existing public infrastructure.** Street assets can be used very easily to scale networks in Smart Cities.
- **Able to serve more than one application**, creating a sustainable business model for local authorities investing in infrastructure

An edge-based 5G Network

5G Private Network built on street side cabinets and traffic lights using industrial equipment.

CHALLENGE: space in the cabinets, available equipment and access to backhaul.



Cloud-based network running on COTS using software tools that cut operational costs.

CHALLENGE: tech not ready to be included in cloud-native, remote control of physical elements such as power.

Create a platform for innovation available to other Smart City Applications to create stackable use cases.

CHALLENGE: Integration into OpenRAN not ready to create seamless automated use case integration.

Why OpenRAN?

Use of shared spectrum band and Small Cells the size of a shoebox.

Avoid lock in to remain cost-effective.

The 5G Network software had to follow a micro-service architecture and API design where disaggregation of components and integration with other components is feasible

Zero-Trust approach to Cybersecurity as an alternative of security by obscurity given by end-to-end deployments provided by a one Vendor solution.

The Network deployment

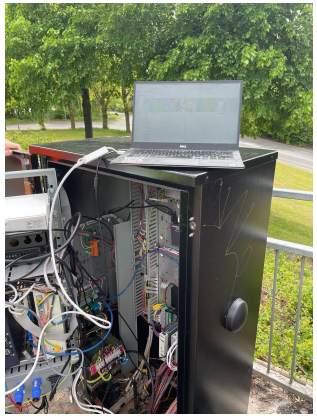
In partnership with telet research

OpenRAN 5G SA

- Accelleran — Small Cells, Done Right
- EFFNET
- ATTOCORE
- Benetel
- Phluido

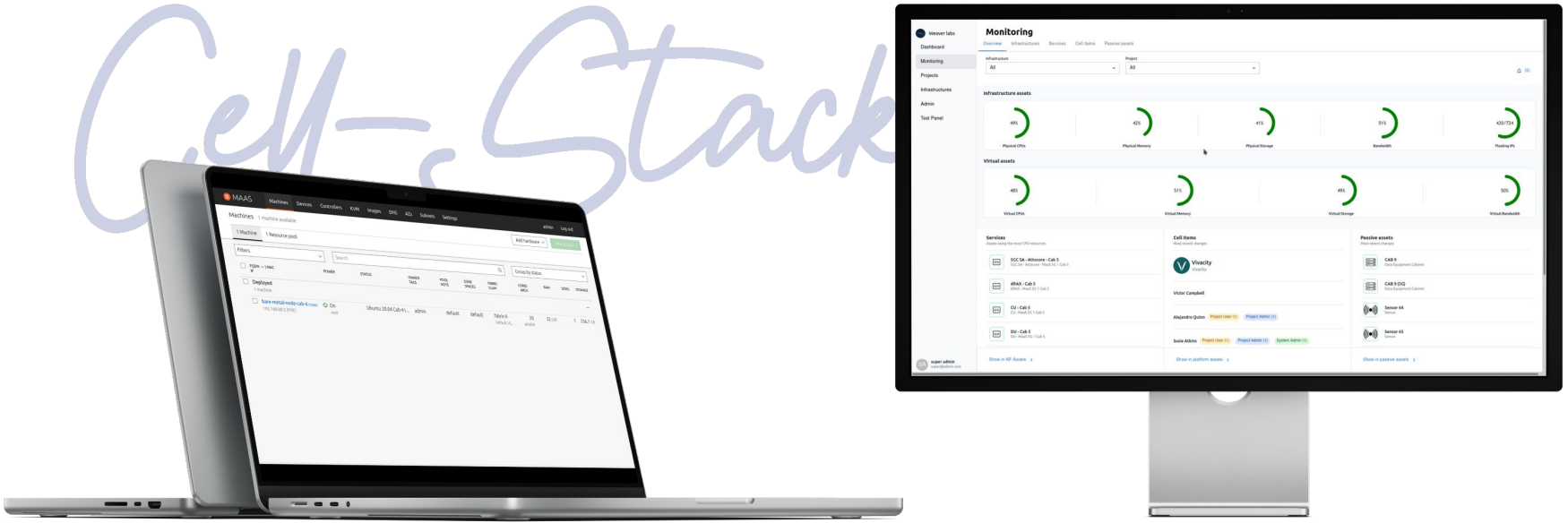
Transport Network

- eunetworks



Edge-Cloud Component

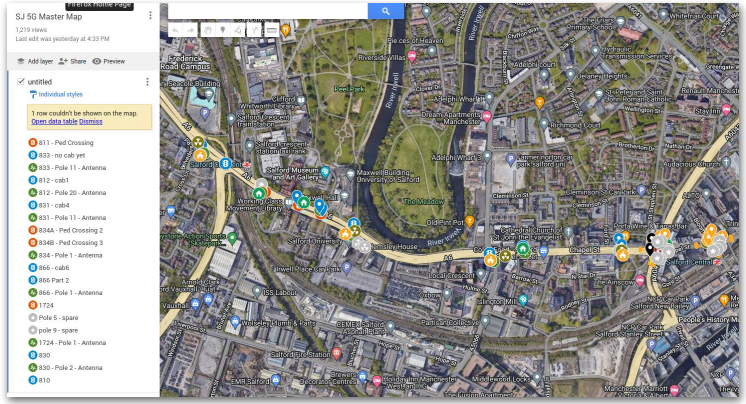
Bare-Metal Cloud to control all resources in the machine and support the network remotely using Canonical MaaS which helps to manage and scale the deployments using automated tools.



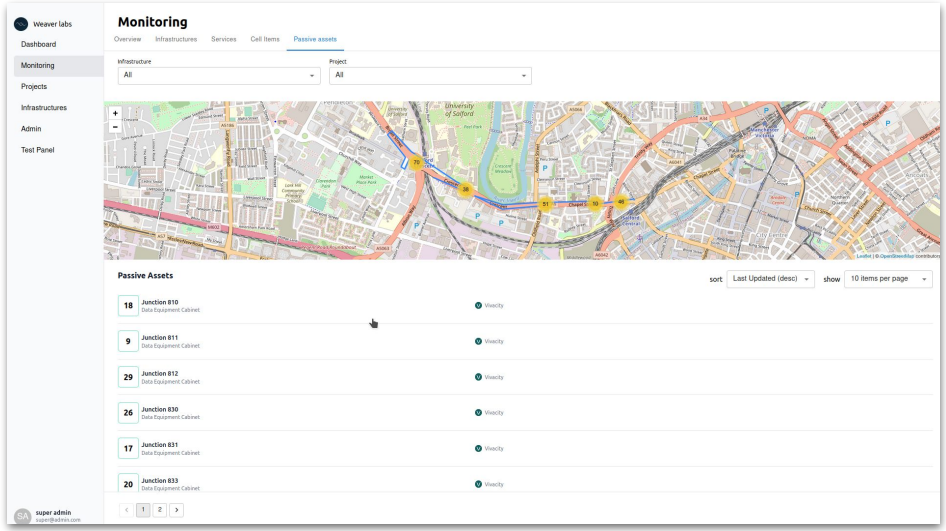
Public Sector owned assets **to build the network**

It took us 9 months to gather all the relevant data of the assets used in the project during the planning phase: there was no single repository of data, no up to date diagrams and multiple layers of data ownership which cost us time and effort to gather.

We built it into Cell-Stack monitoring where these are now mapped using a specific data schema and allows for easy logging of updates.



This became this



At the beginning of the project
we were given the task of building a cybersecurity strategy...

Truth to be told: **it was more challenging** **than we thought**

Cybersecurity Strategy

Lessons learned

- Securing an organisation goes beyond the product or service offering
- We need more clarity on the standards that should be adopted
- New methods to map security principles with postures and best practices
- Straightforward way to measure the risk a given organisation poses

Existing problems

- Large investments to create cybersecurity strategies, which may not be a priority
- A slower adoption of best practices - major impact to Telecoms security requirements!
- A more challenging way to address platforms and adopt innovation across the whole stack

So we took it as an opportunity to *innovate*

Cybersecurity Strategy

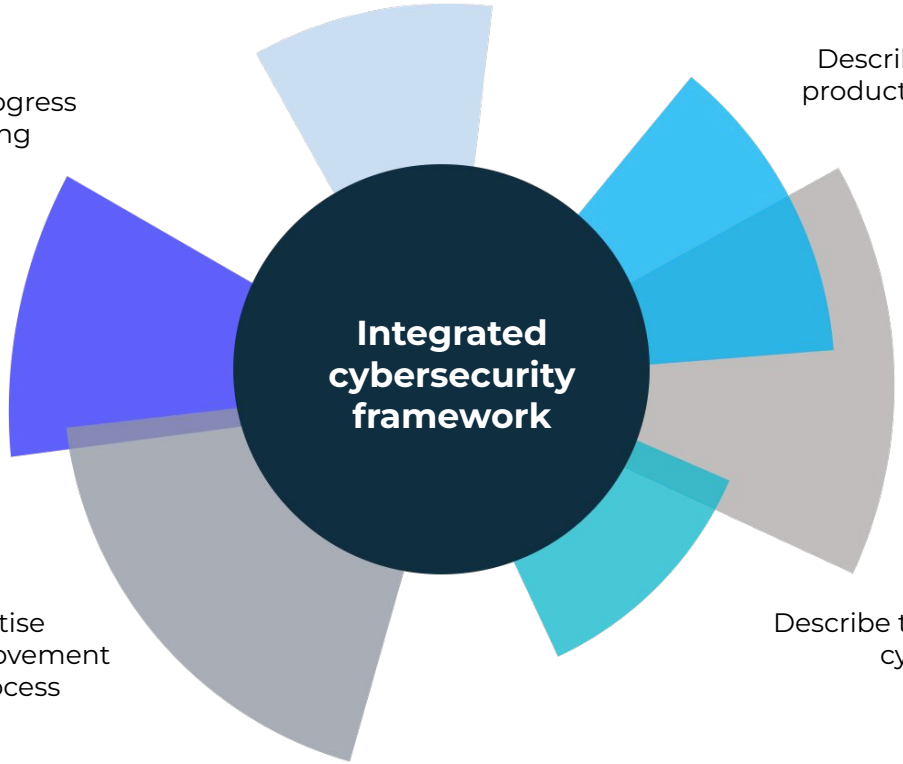
A diverse supply chain needs a common approach!

1.
Describe an organisation or product current cybersecurity posture

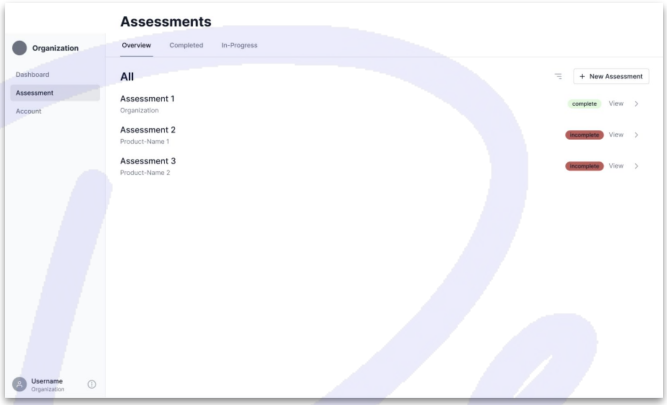
2.
Describe their target state for cybersecurity

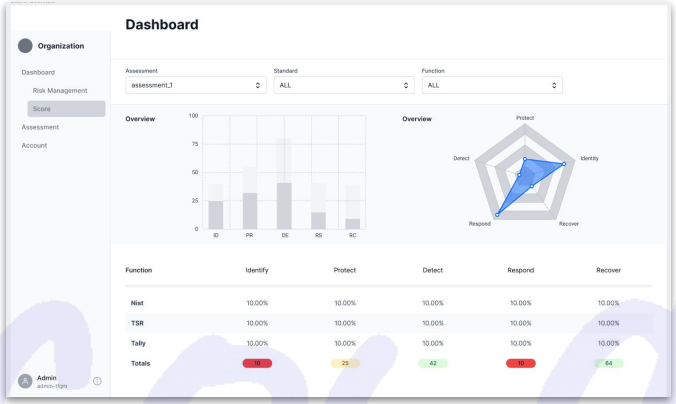
3.
Identify and prioritise opportunities for improvement in a continuous process

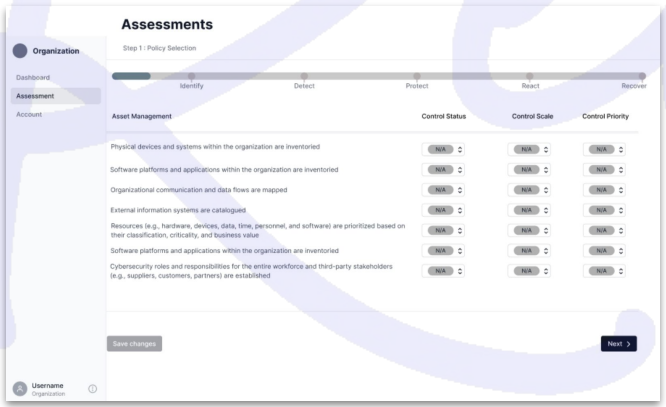
4.
Assess and communicate progress towards target state among stakeholders

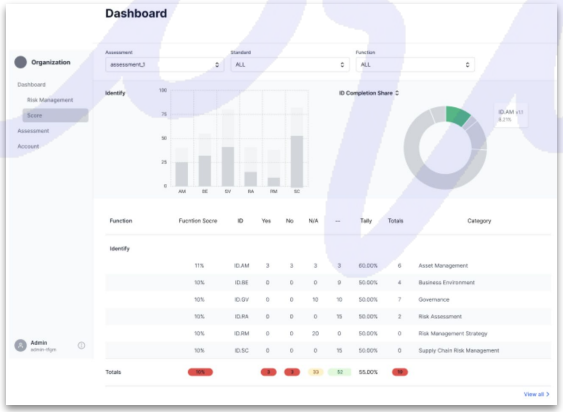


We create a cybersecurity ranking tool









We wanted to build a network that supported 3 pillars

- **A Smart City application** 
- **Vendor diversification and network integration** 
- **New business models for public sector owned infrastructure**

Now we have the basis to use **Cell-Stack** to explore the innovations we can bring into new business models for Telecoms.

TfGM Strategy and Plans

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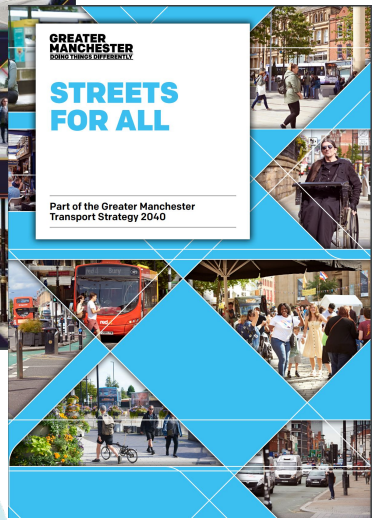
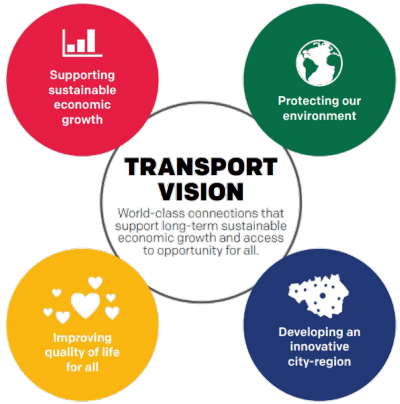
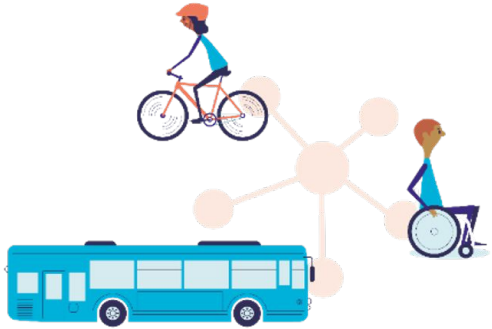
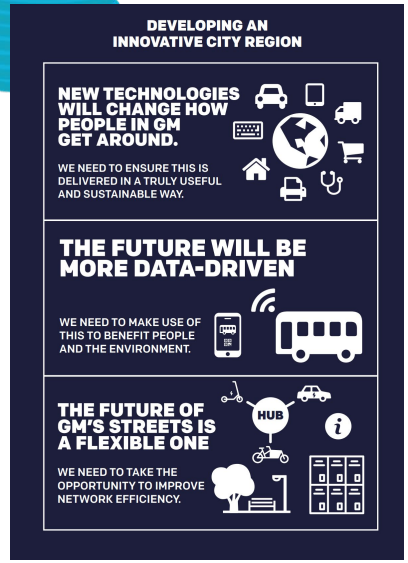
GREATER MANCHESTER
DOING THINGS DIFFERENTLY
GREATER MANCHESTER TRANSPORT STRATEGY 2040
Published February 2017, updated January 2021


GREATER MANCHESTER
DOING THINGS DIFFERENTLY
STREETS FOR ALL
Part of the Greater Manchester Transport Strategy 2040


Supporting sustainable economic growth
Protecting our environment
TRANSPORT VISION
World-class connections that support long-term sustainable economic growth and access to opportunity for all.
Improving quality of life for all
Developing an innovative city-region




DEVELOPING AN INNOVATIVE CITY REGION
NEW TECHNOLOGIES WILL CHANGE HOW PEOPLE IN GM GET AROUND.
WE NEED TO ENSURE THIS IS DELIVERED IN A TRULY USEFUL AND SUSTAINABLE WAY.
THE FUTURE WILL BE MORE DATA-DRIVEN
WE NEED TO MAKE USE OF THIS TO BENEFIT PEOPLE AND THE ENVIRONMENT.
THE FUTURE OF GM'S STREETS IS A FLEXIBLE ONE
HUB
WE NEED TO TAKE THE OPPORTUNITY TO IMPROVE NETWORK EFFICIENCY.

TfGM Innovation Prospectus

R&D

BAU

Health, wellness & wellbeing	Sharing Economy	AI & Data	Connected people and places	Future Energy
A-TRIG – Vision Travel Assist	LIME e-scooter Trial Cargroo e-cargo bike Trial e-Hubs – Mobility Hubs InPost Parcel Lockers	DCMS 5G Smart Junction MISDT case study Mobility Hub Planning Tool (Agent Base Modelling)	Project Synergy CCAV Platoon	BE.EV – EV Charging in GM

Partnership , collaboration and new ways of working

EU Partners - Horizon Europe, POLIS, UITP, CCAM, EMTA
UK National Partners - DfT, DCMS, BEIS, Satellite Application Catapult, InnovateUK

ERDF Greater Manchester AI & Cyber Foundry
Alan Turing Institute

Department for Digital, Culture Media & Sport

UK 5G Innovation Network

Key Narrative

- **Digital & technology** utilising existing highway infrastructure in more efficient manner. Data driven approach to achieve policy objectives
- Digital connectivity (5G) as a mean to reduce the **cost of deploying technology** to aid achieving GM region **decarbonation and green objectives**.
- A GM **digital connectivity blueprint** that can be replicated for other corridors within the region. Creating an **living lab corridor** to demonstrate and showcase future smart cities solutions
- Developed in a partnership approach with SMEs to create an **Open Network Infrastructure** (OpenRAN) to provide flexibility for future developmenth "Use case stacking"

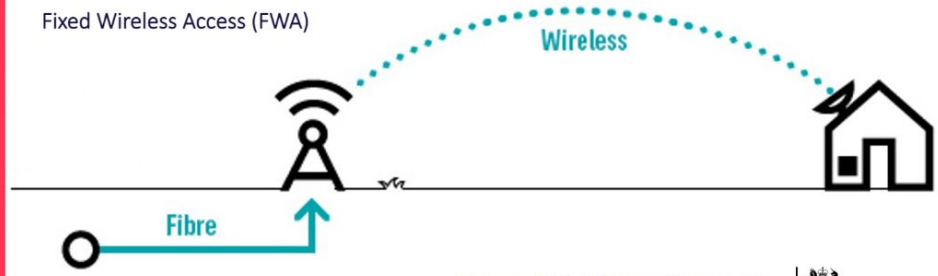
Developing a sustainable eco-system

- Partnership development. SME / Commercial / University and Charities
- Thinking about 5G beyond connectivity and use case. Cyber Security, OpenRAN
- Developing skills and capability supporting the network infrastructure
- Making Public Sector a smarter customer to start considering the art of the possible
- Supporting the Future - Blueprint to Replication at a regional level and replicating nationally

5G Public Sector "Use Case Stacking"

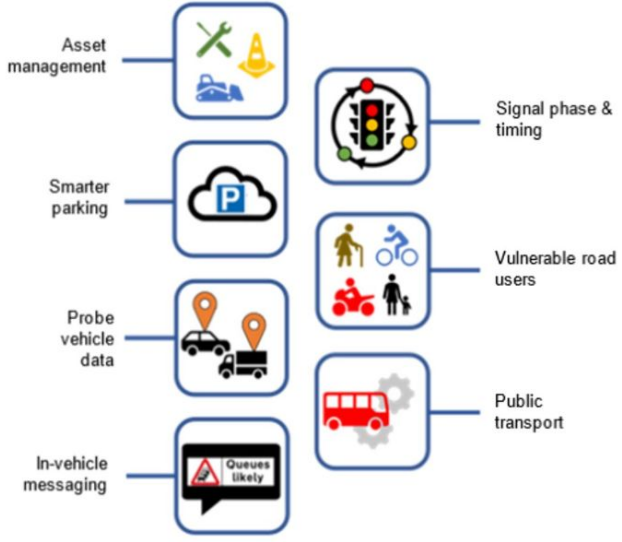
The report will outline use cases that could leverage the 5G corridor as part of the project. Working in partnership with GMCA and GM stakeholders to help determine the commercial sustainability of the network.

Digital Connectivity Poverty / Equality- Fixed Wireless Access (FWA)
Enabling Innovative public services – Digital Health Care
Enabling Innovative public services – Police and Civil Enforcement
Enabling Innovation public service- Future of Mobility and Smart City
Private Sector Use case - Commercial Sustainability
Neutral Host Operational Modal – Telecon Engagement
Enabling Innovation public service – Future of Education



Future of Mobility and Smart City
Connected Vehicle Strategy- DfT

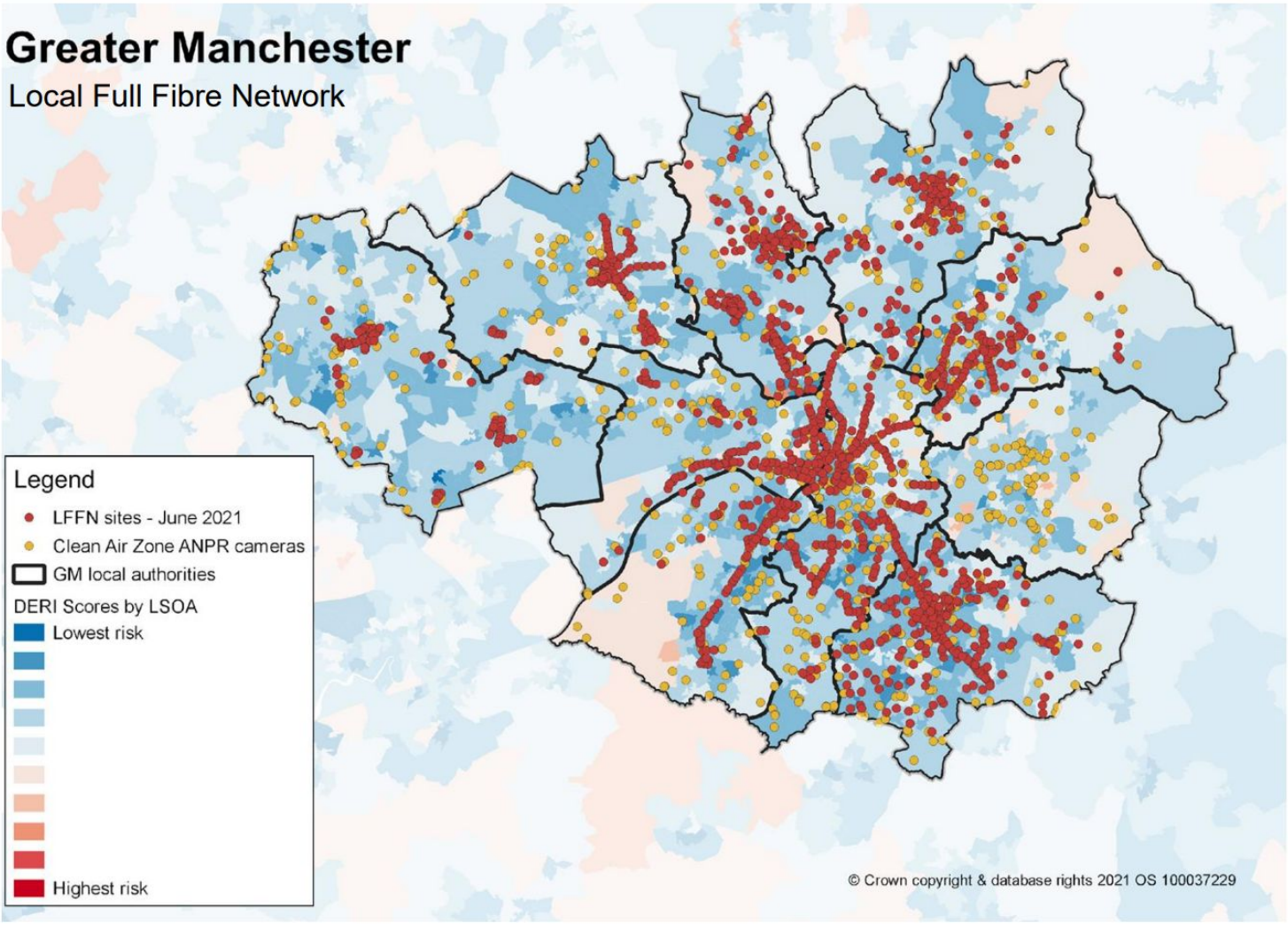
Department for Transport



Building Digital UK

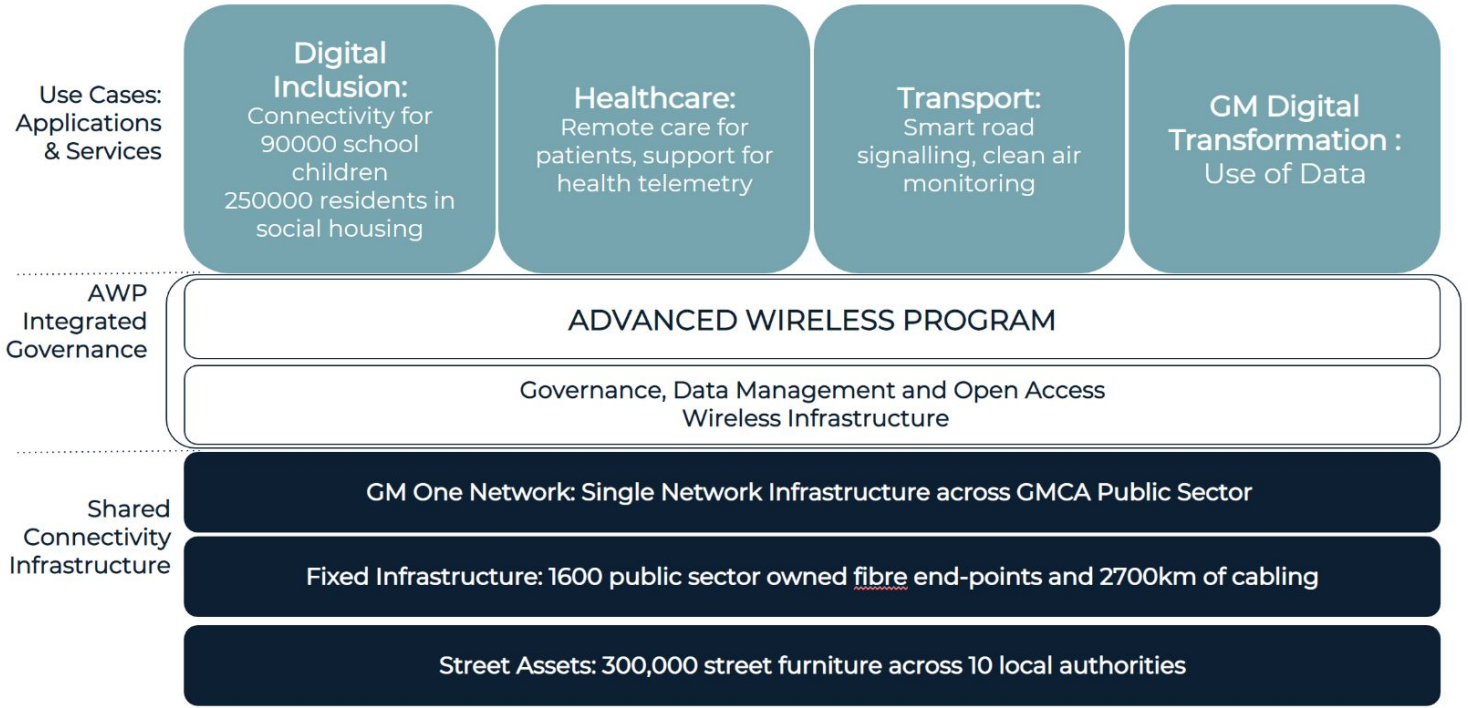
Greater Manchester

Local Full Fibre Network

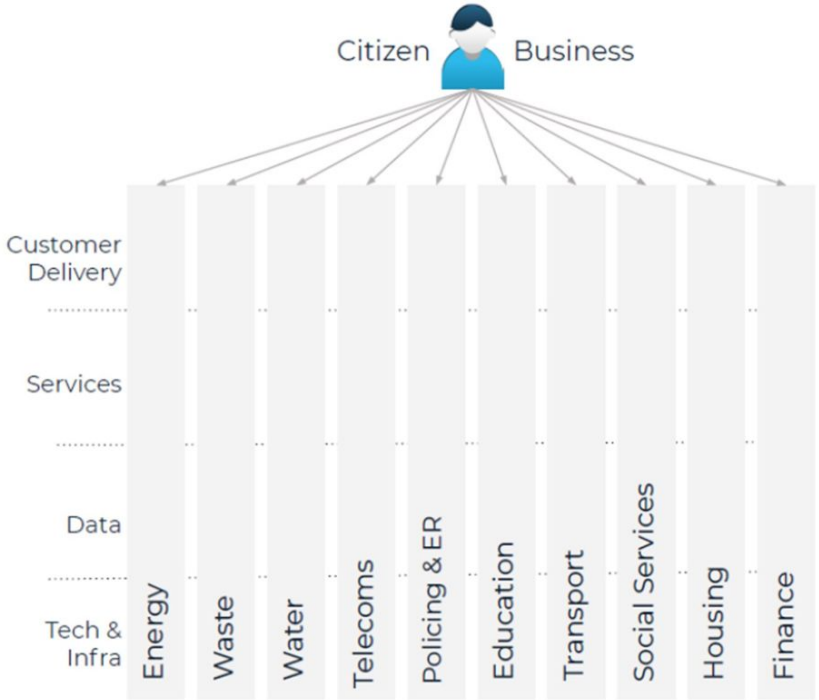


The Advanced Wireless Program fills a gap

By implementing an integrated wireless layer to support the delivery of existing and new services

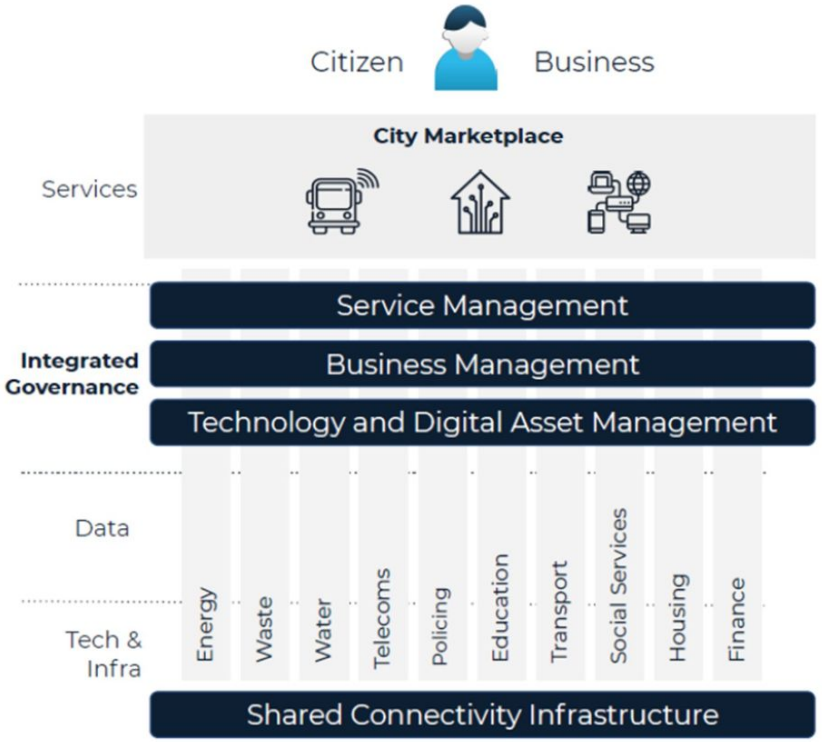


Traditional Model



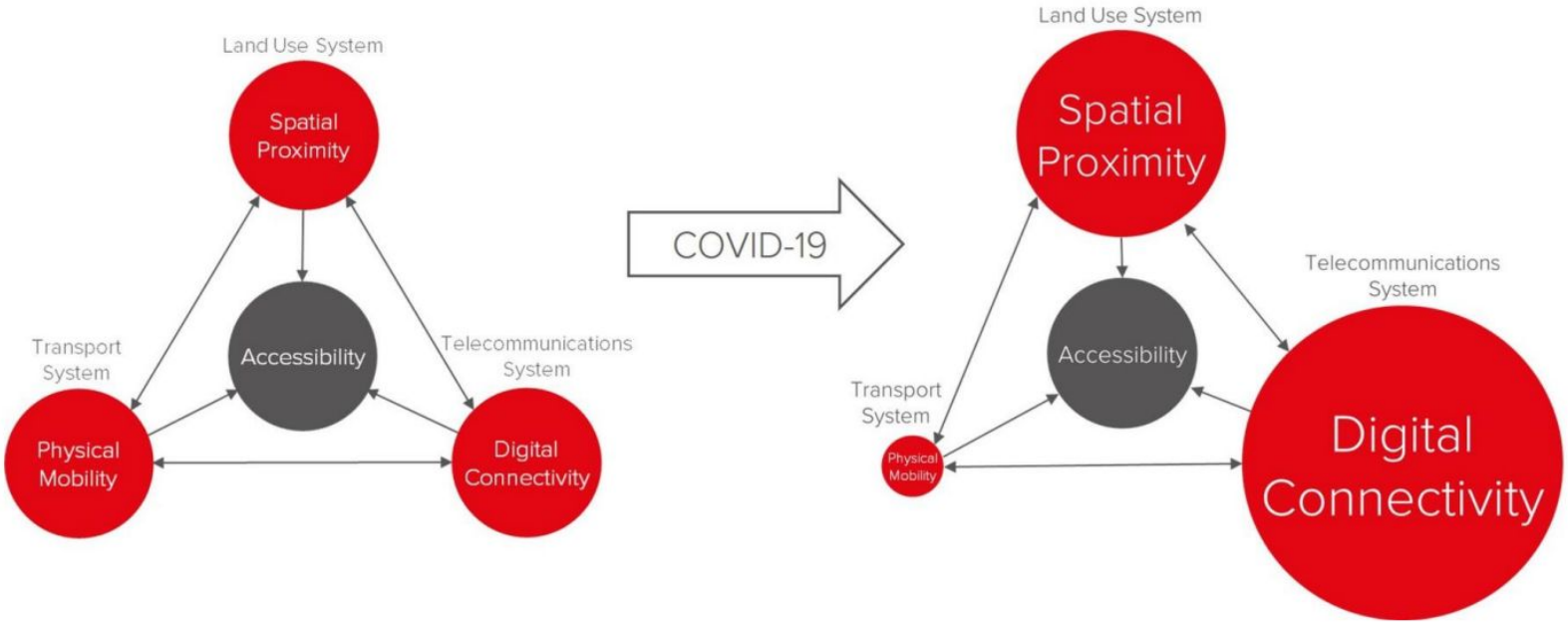
- Built on silos and not connected → Inefficient
- Closed and difficult to access for innovation
- No ability to scale to provide cross-sector citywide solutions

New Integrated Model



- Shred infrastructure with aggregation points for data management and governance
- Enables external innovation for services
- Flexible and agile to grow → Better ROI

Discovering the triple access planning 'sweet spot' : - Glenn Lyons



https://www.transportxtra.com/publications/local-transport-today/news/68866/discovering-the-triple-access-planning-sweet-spot-/

"The time is coming where we need to see digital connectivity as a basic human right. Without it, people will be shut out of the conversation, lose access to essential services and miss out on a whole range of opportunities.

"This is why I am setting a new ambition to help all under-25s, over-75s and disabled people in Greater Manchester to get online."

Andy Burnham
Mayor of Greater Manchester

Results and Findings

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So,

How has

Testing Gone…

Latency Data Dashboard (Site 830)

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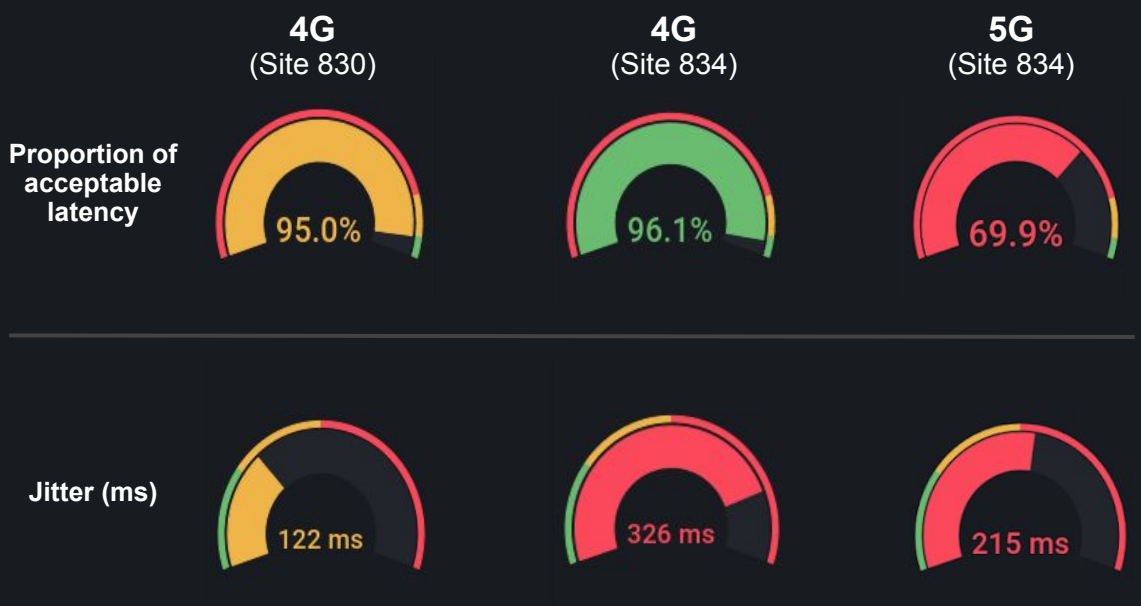
Junction Control Latency Results



5G Connection currently unstable

Connection dropouts

Currently proportion of acceptable latency is better for 4G on average

Jitter effects noticeable by University site

Low number of device connectability

Peak Period Latency Results

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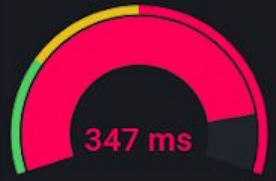
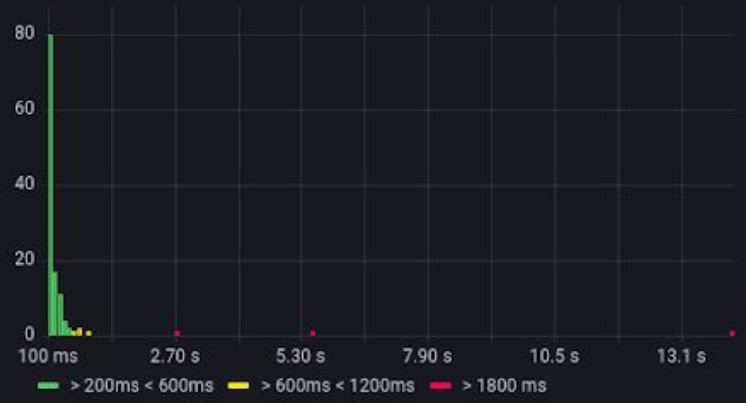
4G

Proportion of acceptable latency

Jitter (ms)



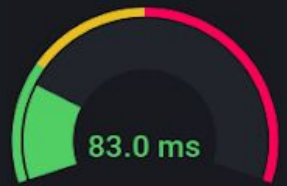
UDP uplink latency histogram



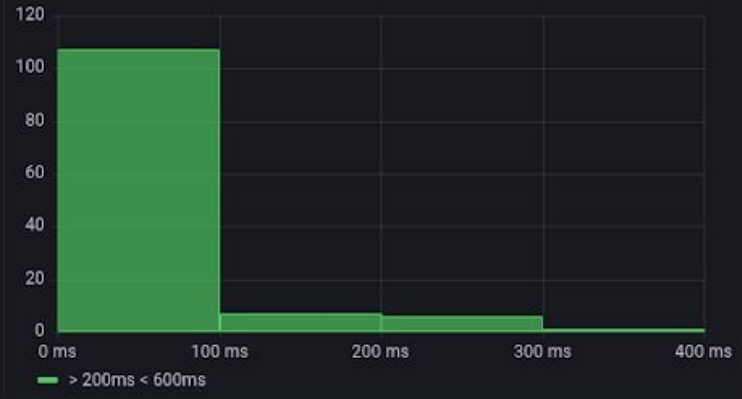
5G

Proportion of acceptable latency

Jitter (ms)



UDP uplink latency histogram



WebTag Analysis

1%

Further Journey Time Improvement on 5G (up to 23% improvement already achieved in Manchester)

100 Seconds

Average Journey Time

£45k

Yearly Total Road User Cost Saving at 1 Junction

16 Million

Journeys a year

4 Arm

Urban Junction

Cost Benefit

75%
Cost saving over single vendor approach

£250k
5G Network Cost

£170k
Hardware, Software & Backhaul

£30k
Installation

£50k
Operational

£6.5k
1 SJ on Ethernet

£6.2k
8 SJ on 5G


Transport for
Greater Manchester
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THANK
YOU

Department for Digital, Culture, Media & Sport | Weaver Labs | Transport for Greater Manchester | VIVACITY

Welcome to the future

Smart Junctions 5G End of Project Showcase

Lessons Learned Panel Session

Time:
12:45 PM - 1:30 PM

Alex Cleaves
Moderator

Hannah Tune

Alexander Yeomans

Maria Lema

Ed King

Department for Digital, Culture, Media & Sport | Weaver Labs | Transport for Greater Manchester | VIVA CITY

REFRESHMENT BREAK

Department for Digital, Culture, Media & Sport | Weaver Labs | Transport for Greater Manchester | VIVACITY

Welcome to the future

Smart Junctions 5G End of Project Showcase

Transport Panel Session

Time:
12:45 PM - 1:30 PM

Sam Li
Moderator

Peter Boulton

Peter Mildon

John Paddington

Department for Digital, Culture, Media & Sport | Weaver Labs | Transport for Greater Manchester | VIVA CITY

REFRESHMENT BREAK

Department for Digital, Culture, Media & Sport | Weaver Labs | Transport for Greater Manchester | VIVACITY

Welcome to the future

Smart Junctions 5G End of Project Showcase

Future of Networks Panel Session

Time:
3:45 pm - 4:30 pm

Maria Lema
Moderator

Andy Sutton

David Pedley

Mick Goulding

Nigel Linge

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Welcome to the future

Smart Junctions 5G End of Project Showcase

SPECIAL GUEST:

Minister of State
Matt Warman MP

Giving the closing remarks