Connecting Manchester

How BT's Internet of Things solutions became central to the CityVerve smart city project

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An introduction to CityVerve

Manchester's CityVerve project brings together 21 organisations – including BT – to create a blueprint for smart cities of the future.

Running from July 2016 to June 2018, it sees local authorities, start-ups, universities and major technology partners apply the latest Internet of Things (IoT) innovations to a number of use cases. They'll show how IoT can help improve healthcare, make streets and transport safer, and inform and empower citizens.

CityVerve's use cases are based around four themes; Transport and Travel, Energy and The Environment, Health and Social Care and Culture & The Public Realm. From allowing passengers to 'check in' at their bus stop (so providers get a better picture of service demand), to smart lighting that responds to the movement of people below, everything is designed to have a positive impact on Manchester's citizens.

Backed by a £15 million collaborative R&D budget (including £10 million from the UK government), CityVerve's use cases will show how a smart city programme can be rolled out across the world. They'll demonstrate the benefits that IoT technologies can bring, as well as the challenges of applying them at scale.

A smart city project like no other

CityVerve isn't the first project of its kind to explore how the internet of things can improve cities. But it is unique. Manchester's local authority – thanks to increasing devolution from Westminster – has more control over education, health and transport policy than other cities. That gives it more flexibility when it comes to applying IoT technologies and using the data it generates to inform decision-making. The city's geography and demographic is large enough to make it a true testbed for other urban areas too.

Collaboration in the centre

CityVerve's unique approach doesn't end at its local authority powers and geography either. Collaboration is high on the agenda here – between partners and with the public. Recognising that no single company can build a smart city, CityVerve has brought together 21 organisations, ranging from local universities and NHS trusts, to innovative start-ups and global technology companies. With everyone working together and pooling expertise, CityVerve is pioneering a way of thinking that's never been applied to a smart city project before.

At the heart of this large-scale collaborative project is the need to do more with data, and take it outside of traditional silos. That job comes down to BT.

“Connecting the unconnected”

That’s how Professor John Davies, Lead Researcher at BT, describes BT’s involvement in CityVerve.

With around 200 separate data feeds to work with, bringing them all together in a way that’s easy to manage, interpret and work with is vital. By creating an IoT data hub, data silos can be broken down and developers can combine feeds from across the project. This combination of different data feeds means new insights and better services for Manchester’s citizens.

BT’s leading role in creating the Hypercat specification – a catalogue format for IoT data hubs – made it the obvious choice when it came to bringing together the various CityVerve data feeds. By creating a data hub with Hypercat availability, data is far easier for developers to find and work with – no matter where it came from originally.

A hub at the heart of it all

BT’s IoT Data Hub – one of a handful of platforms that make up the project – sits at the heart of CityVerve. It plays a vital role in bringing together hundreds of travel and transport and other data feeds generated by different use cases, sensors and organisations across Manchester.

With Hypercat availability built in, the hub does the hard work of presenting information about each data source in a uniform and machine-readable format. With it, developers can easily see what’s available and use it as part of their applications. That lowers the barriers to participation when it comes to creating new services and solutions with CityVerve’s data. And that means everyone can get involved – from large organisations to individual, entrepreneurial developers.

Hypercat doesn’t just open up BT’s data hub to developers either. It makes it interoperable with other data hubs that form part of the CityVerve project. With full interoperability between hubs, different data sources can be combined – between health and transport data, for example – to deliver insights that were never previously possible.

The challenges of bringing together so many different data feeds go beyond making them discoverable. With many different data providers involved, BT had to make sure that their individual terms and conditions for data use were respected. As a result, the CityVerve data hub allows data providers to supply data feeds under their own terms and conditions.

The CityVerve hub is built on the experience and knowledge that came from creating the MK:0Smart Data Hub, in collaboration with the Open University, for Milton Keynes. But with a larger city comes more data, and more feeds to contend with, so the hub has to be scalable.

“We need the data hub to stay scalable and efficient,” explains Davies, “it can’t get slower as it becomes home to more and more information.” This drive for scalability and efficiency not only ensures that it provides value for money for the CityVerve project, but also that developers working with the platform can truly make the most of it in years to come.

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What is Hypercat?

According to a report by McKinsey[1], interoperability is essential to unlocking up to 40% of the $11 trillion potential of IoT. And that means data needs to be easier for developers to access and combine from across different sources. Without interoperability between data hubs, they’ll become data silos and limit the progress of IoT innovation.

The Hypercat specification creates interoperable, machine-readable catalogues for IoT data. With Hypercat, developers can ask IoT data hubs, “What have you got?” and, “How do I get it?”. With automated data discovery, the barrier to innovating with IoT data is lower for everyone and different data hubs can talk to each other.

There are two parts to Hypercat – a JSON file format for cataloguing IoT resources (a Hypercat file) and a web API for fetching, serving, searching Hypercat catalogues (the Hypercat web API). Both are open source, royalty free and based on well-used web technologies. This ensures the barrier to entry and adoption is low. As a result, Hypercat is currently used by around 15–20 different data hubs.

Hypercat is developed by BT along with a number of leading IoT organisations that form the Hypercat consortium. Right now, Hypercat is a British Standards Institute Publically Available Specification (PAS) and is well on its way to becoming an international standard, pending the appointment of an appropriate international standards body.

The privacy balancing act

Smart city applications can often be enhanced by the use of citizen information. And citizens have a right to know how their data is being used – and by whom.

With the amount of data generated by CityVerve's IoT use cases, privacy is a top priority.

BT's work in the project involves implementing a privacy portal that Manchester's citizens can use to decide how their personal data is collected and used as part of the project. By adopting a standard-based approach, the new portal is easy for everyone to use and integrate with. BT is working with oneM2M's Privacy Policy Manager (PPM) specification and is integrating it with the CityVerve Data Hub.

With the PPM, citizens can set their own preferences for how their data can be used. These are logged within the PPM as the end user's 'terms'. Similarly, applications created using CityVerve data are asked to set their data requirements within the PPM.

This creates a matrix that matches each application's data requirements against each end user's privacy terms. In cases where there's a mismatch, end users are asked to consent to their data being used by a specific application.

A street full of sensors

As the technical lead on CityVerve's travel and transport use cases, BT is working with a range of partners to make travel across Greater Manchester greener, faster and easier.

Central to all of this are the sensors found everywhere from bus stops to bikes. With the data these sensors produce, IoT applications can paint a true picture of how Manchester's citizens, visitors and commuters travel throughout the city. And this can lead to better decisions, investments and upgrades to roads, transport services and traffic systems.

Shedding light on Manchester's cyclists

Working with SeeSense (winners of BT's Infinity Lab Connected Cities competiton), BT are gathering data that can help guide decisions around everything from upgraded cycle routes to accident prevention.

With an army of 180 willing volunteer cyclists, SeeSense's ICON smart cycle lights were installed on their bikes and used around the city every day. The cycle lights link up to a smartphone app via Bluetooth and transmit data to the BT CityVerve Data Hub. "This data collection and sensor communication works in two ways," explains John, "firstly, to make the bike light flash brighter and faster in riskier situations, such as crossing busy junctions or approaching roundabouts, and secondly to feed back data about routes taken and the cycling environment."

With a number of sensors packed inside, and a connection to their smartphone app, ICON lights know when they're approaching a dangerous stretch of road or junction, while motion sensors can detect road conditions and bike movement. In the event of an accident, they can send text messages to alert friends or family.

The data that SeeSense's smart lights provide is incredibly useful. On the most basic level, it's simple to overlay cyclists journeys onto route maps, while data on speed, braking and wait times can be added to show where there's congestion.

This could be used to help Manchester City Council make better investment decisions in the city's cycling infrastructure – upgrading the busiest routes to ensure everyone gets from A to B without a hitch.

But, where the project really comes into its own, though, is with deeper data insights into areas like road condition. Sensor data on ride smoothness can be used to assess road condition and, in the future, even detect potholes. And, data on accidents makes it easy to identify collision hotspots. All of this means Manchester's roads and cycle routes can be repaired and modified in a way that gives the most value for money and potentially even saves lives.

A second use for SeeSense sensors

As well as collecting valuable travel and transport data via the city's cyclists, BT is also using SeeSense devices to test CityVerve's new LoRaWAN network. They'll check LoRaWAN-enabled devices' power requirements, network coverage, penetration, data ranges and volumes, and links to BT's IoT Data Hub.

The network itself is being built by both BT and CISCO and is used to connect devices with low data rates and long battery life that operate unattended for long periods of time. Six LoRa servers are being provided across the Greater Manchester Area. With them, and the networking put in place with CISCO, every partner on the CityVerve project gets another option when it comes to connecting IoT sensors and devices.

What is LoRa?

LoRaWAN is a Low Power Wide Area Network specification, designed specifically to support wireless, lower power IoT sensors. Devices connected to a LoRa network can use very little power, giving them a long battery life and making them a low cost, long range solution for IoT applications.

By installing base stations across cities, it's easy to create a LoRa network that can be used by different devices and sensors, from different providers, to generate new data and power innovation across a whole range of use cases.

BT have a track record for pioneering LoRa networks, installing 25 base stations across London. The BT Tower is home to the tallest LoRa base station in the world.

A celebration of collaboration

By placing collaboration and integration at the heart of CityVerve, the project is proving that great things can happen when the right partners, people and datasets come together.

Without great connections, the Internet of Things is just 'things'. Separate objects, ideas and innovations that might well be great in their own right, but aren't fulfilling their full potential. With CityVerve, new connections, collaborations and discoveries are being made at every stage of the project.

BT's IoT Data Hub has brought together around 200 different datasets, provided by different organisations and partners throughout Manchester. Everything from parking data and automatic traffic counts, to Met Office weather observations, air quality data and Highways England traffic density data now lives in a single hub that's easily accessible to everyone involved in CityVerve. And the results speak for themselves.

By combining traffic count data with air quality data from the Met Office, for the first time, it's easy to see a clear correlation between Manchester's traffic and pollution levels. Although the link has always been present, the data generated by CityVerve now gives a clear indication of the point when traffic levels start to have serious impact on pollution in the city. This gives Manchester's authorities a clear picture of exactly where to funnel investment that can reduce traffic and ultimately reduce pollution, helping to improve the lives of people who live and work in the area.

For cyclists, BT's work with SeeSense smart cycle lights has revealed the use of particular 'cut-through' routes that weren't always obvious to the city's planners and transport bosses.

Again, this data will prove invaluable when it comes to deciding how (and where) to invest in Manchester's future cycling infrastructure. Both of these use cases show how IoT can be used to create smart cities that truly improve citizens' lives. And Manchester isn't the only city that'll benefit. BT is using the learnings from the CityVerve project to develop the new Smart Cities Starter Kit – helping other cities around the UK and beyond take advantage of IoT technologies to gain new insights into how travel, transport, energy, services and buildings are used.

To find out more about the CityVerve project or the Smart Cities Starter Kit call 0800 671045 or email clientreception@bt.com

1. Unlocking the potential of the internet of things; McKinsey Global Institute, June 2015