Riot: tracking disruptive technology and its impact in industry

Anatomy of a 5G Smart City

What makes a smart city once 5G arrives?

Executive Summary Only

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1). Introduction

Ever-increasing urban migration and populations are going to put serious strains on cities that do not adopt technologies to accommodate the influx of people to their streets. New technologies like Software Defined Networking (SDN) will be key to supporting the massive scales required to manage growing populations—which threaten to overwhelm existing services. This month Riot talked to the City of Bristol, to try to work out what are the right ingredients to make your City truly smart. Bristol in the UK is hoping to find a formula that can power its next-gen citizen services, and eventually monetize those findings through licensing the technologies.

Each week, around a million people migrate to cities, in a trend that will continue for the next thirty years – meaning that by 2050, two-thirds of the expected global population of 9bn will live in cities. Many cities are already embracing smart city tech, with the likes of Singapore, London, Barcelona, San Francisco, and Tokyo usually populating the 'top smart cities' polls. Bristol's fiber network, which enables its SDN deployment, has allowed it to become a leading smart city in the UK—overtaking London by many measures.

Bristol is the largest urban area in South West England, and is situated about two hours' drive West of London. With a population of 454,000, the port city has a strong industrial heritage – both in transatlantic trade, and engineering works (many of which powered the UK's Industrial Revolution), and is also the home of Rethink Technology Research.

It is pursuing a smart city strategy via Bristol Is Open (BIO) - a project involving local and national governments, media companies, universities, and technology providers. Governed as a joint venture between the University of Bristol and Bristol City Council, long-term members can join the advisory panel that guides the project, and together they decide on the experiments carried out in the city.

The goal is to create an open and programmable city, which can give its citizens more ways to participate in the running of Bristol – via the data generated by the system. Termed 'City Experimentation as a Service,' Bristol Is Open is not so much a smart city, as a testbed to find the best ingredients for a smart city, not just for Bristol, but for its technology partners. This will allow it to manage its data and services, use an open and technology agnostic approach for its procurement, and share its findings with the wider smart city community via its adherence to OpenDaylight standards – a Linux Foundation project for software-defined networks (SDN).

Bristol's smart city project has its origins in ducting installed by cable TV company Rediffusion, originally used for putting TV into all the houses in Bristol around ten years ago. The ducts now house the fiber optic cabling that powers the Bristol is Open network – after Rediffusion went bust and the council bought up the underground assets—before smart cities were really a 'thing'.

The city began using the fiber for connecting council offices and depots, but in 2012, the national government's Department for Media, Culture, & Sports (DMCS) launched its Connected Cities funding initiative—and Bristol has used the cash to explore some bleeding-edge smart city approaches, which are explored here.

Participants:

BIO is led by the City Council and the University of Bristol. The Industry Partners are the next tier down, and consist of InterDigital (wireless and mobile developer), NEC (ICT product and service provider), and Nokia (networking specialist).

Joining as local host and ecosystem partners (LHEP) are fellow academic institutions; University of Bath, University of the West of England (UWE), and Bath Spa University. Other local councils that have joined at this tier include Bath and North East Somerset, and South Gloucestershire, and the West of England Local Enterprise Partnership (WELP – a regional business development organization).

The other LHEP partners are mostly local Bristol businesses, ranging from legal advisors to charities. The Supporter tier, the UK Department for Culture Media & Sports, Department for Business Innovation & Skills, the techUK development group, the government backed Digital Catapult and Future Cities Catapult projects, and the Open Data Institute.

Recent Projects—a quick recap:

The list of Supplier members will likely prove more familiar to non-Bristolian readers: Blu Wireless (wireless chips, specialist in 60GHz), Brocade (storage and networking equipment, now owned by Broadcom), Dell (IT services and products), Evans & Sutherland (digital planetariums), Hangzhou Huatai Optic (HFC broadband optical transmission equipment), Hitech Global (FPGA board provider), Infivision (video gateways), Laser 2000 (photonics provider), Mellanox (InfiniBand and Ethernet networking), National Instruments (testing equipment), and PLDA (PCI networking and FPGA developer boards). As you can see, having a strong fixed line underpinning is just one step, you still need a list of partners as long as your arm.

In November 2015, the Open Networking Foundation announced its support for BIO's Software-Defined Networking projects, which brought with it the support of the ONF members – which include Deutsche Telekom, Facebook, Google, Microsoft, and Verizon, and their enthusiasm for promoting open SDN technologies, like OpenFlow.

InterDigital joined the BIO project in December 2015, and a couple of months later, in February 2016, NEC Corporation signed up as a long-term partner, expanding on a previous Memorandum-of-Understanding that saw NEC supply BIO with IT and communications tech that included SDN-compatible network switches, LTE small cells, and iPASOLINK mi-

crowave systems.

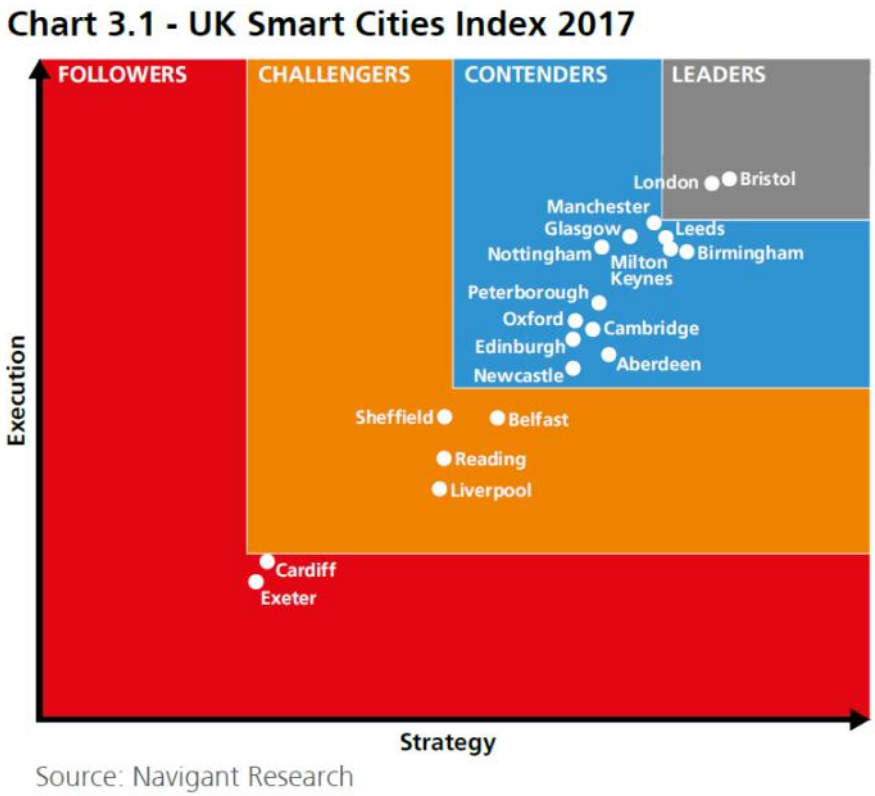
In March 2016, Lund University researchers and National Instruments set a new world record for 5G wireless spectrum efficiency, using multiple antenna (MIMO) tech to create a base station with 128 antennae to achieve a 79.4 bits/Hz throughput that is akin to 1.59Gbps in a 20MHz channel in the 3.5GHz range. The MIMO demo was carried out at a Bristol University building, as part of BIO, and can be seen here.

Nokia joined the BIO project in October 2016, as did Zeetta Networks – both of which are covered later in this report. The next month saw BIO win the World Communications Award's smart cities contest, and then in February 2017, BT and BIO announced additional MIMO trials for 5G – which saw BT, National Instruments, and Lund University expand that spectral efficiency record to over 100 bits/Hz and exceed 2Gbps in a 20MHz channel.

The 5G testing is going to continue in the coming months – with a prominent test due to begin, although it should be noted that it is not a BIO project. Nokia, BT, and the University of Bristol will be firing up a 5G based proof of concept test in March 2018, built in the city-center.

Using Nokia radio access points, BT spectrum (in 32GHz and 33GHz), and backhauled via the BIO fiber core, with plans to eventually expand the project into nearby Bath. Bristol is a somewhat unique testing ground because of that fiber core, which should be capable of supporting the huge potential bandwidths of 5G networks. Every other smart City out there has to contend with the issue of how can the City itself backhaul its own 5GG.

BT's Chief Architect, Neil McRae, said "we're gaining a



Source: Navigant Research

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Rethink Technology Research Ltd,
Unit G5, Bristol & Exeter House, Lower Station Approach,
Temple Meads, Bristol, BS1 6QS
Tel: +44 (0) 117 925 7019
Website: www.rethinkresearch.biz

Riot's main contributors

Editor and Senior Analyst: Alex Davies alex@rethinkresearch.biz
Analyst: Thomas Flanagan tommy@rethinkresearch.biz
Alex Davies was the author of this report

Rethink leadership

CEO: Peter White peter@rethinkresearch.biz
Research Director: Caroline Gabriel caroline@rethinkresearch.biz

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Rethink is a thought leader in quadruple play and emerging wireless and IoT technologies. It offers consulting, advisory services, research papers, plus three weekly research services; **Wireless Watch** which has become a major influence among leading wireless operators and equipment makers and **Faultline**, which tracks disruption in the video ecosystem, which has become required reading for anyone operating in and around quad and triple play services and digital media. **Riot** is Rethink's latest research service focusing on IoT and disruptive enterprise technologies like AI.

Sales contact details

John Constant +44 (0)1794 521 411
Email: john@rethinkresearch.biz