Enabling Neutral Host

Network Economics: CCS case study

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Table of Contents

Executive Summary **4**
1 Introduction **4**
2 Business Imperative **5**
3 CCS & the Solution **5**
3.1 Metnet Solution 5
3.1.1 Metnet for 24~28GHz bands 5
3.1.2 Metnet for 60GHz band 6
3.1.3 Software-defined network and self-organising network architecture 7
3.1.4 Enabling neutral host model 8
3.2 Applying the solution to the mobile network 8
3.3 Key differentiation points of Metnet 8
4 Economic benefits **9**
4.1 Investment rationalisation 9
4.2 Cost sharing via neutral host 9
4.3 Potential revenue creation opportunities 9
4.4 Testimonials by CCS customers 9
5 Implementing Metnet in the City of London **10**
5.1 Market context 11
5.2 The neutral host infrastructure deployment project 11
5.2.1 Plan 11
5.2.2 Key considerations 11
5.3 Metnet Network siting – challenges and resolutions 12
5.4 Milestones and future plans 13
6 Lessons Learned **13**
7 Summary **14**

Executive Summary

As part of the Future Networks Programme, Network Economics work stream, a series of case studies have been developed, exploring areas where Operators can potentially reduce their Operational Expenditure (OpEx) and Capital Expenditure (CapEX) through the application of neutral host model, where two or more operators rent a single network infrastructure that is deployed/operated by a non-operator 3rd party (may be affiliated with operator(s)). This case study focuses on the cost-effective deployment of alternative transmission solution that enables more than two operators to use the same network infrastructure (i.e. enabling neutral host model).

CCS (Cambridge Communication Systems) provides a self-organising mmWave wireless mesh network solution called Metnet. CCS Metnet is designed to augment a new or existing fibre network to provide a low-cost, last-mile mmWave backhaul solution in dense urban areas. Fibre connectivity to every site is not economically or practically possible, so a wireless solution is required to enable street-level connectivity at a suitable cost point. This solution enables other operators to lease the transmission network infrastructure, enabling neutral host models. The USP (Unique Selling Proposition) of Metnet is that it enables an operator to reduce the TCO of the backhaul network, with the investment on infrastructure most likely to be covered within 1-2 years after deployment. As Metnet provides transmission not only for small cells but also for Fixed Wireless Access (FWA), CCTV and other fibre extension applications, operators can expect to benefit from additional revenue streams in addition to cost reduction.

As networks evolve through 4.5G to 5G, with the requirement for ultra-dense networks and even more performance improvements, there will be an intensified need to deploy transmission network infrastructure more cost-efficiently, and to enable neutral host models in order to address the related cost challenges (CapEx and OpEx).

1 Introduction

As data traffic demands grow, operators are faced with the challenge of densifying their networks while minimising any increases in network cost. One of the potential approaches for operators is to share the deployment and operations of the network infrastructure. In the era of burgeoning small cell deployment and network densification, operators are taking this a step further with the idea of having a single network infrastructure that is owned by a non-operator 3rd party – possibly associated with operator(s) – and that can be leased to any interested operators.

With the emergence of 5G networks, a key requirement is that networks will need to be densified to meet even more stringent low latency and high throughput requirements. As a result, and using traditional approaches, not only are the deployment and operations overheads likely to be more expensive, but the strain on the transmission networks will also be significant as 5G prepares to serve up to 20 times the bandwidth served by 4G LTE. Therefore, the traditional approach of operators independently deploying and operating their own network infrastructure must be reconsidered, and operators must adopt innovative approaches to the network infrastructure itself.

In this context, it is natural to look into alternative transmission solutions that enable neutral host infrastructure models and that simultaneously create new revenue opportunities.

Alternative transmission solutions available now allow network infrastructure to be deployed and operated at a lower cost and within a shorter timeframe. The cost reduction is maximised by multiple operators sharing the infrastructure via a neutral host model. Furthermore, the network infrastructure can be used for other services to create additional revenue streams, creating more incentives for operators to adopt the solution.

2 Business Imperative

It is possible to resolve these challenges by sharing the deployment and operations of the network infrastructure among multiple operators. This can be taken a step further to the idea of neutral host, where one network infrastructure, owned by a non-operator 3rd party – possibly associated with operator(s) – is leased to any interested operators.

A base network for multi-operator use needs to deliver superior performance (e.g. throughput) and it naturally calls for the use of mmWave spectrum. However, there are many issues to overcome when deploying mmWave solutions for backhaul in dense urban areas, for example, line-of-sight, GPS difficulties due to tall surrounding buildings, limited site availability, sub-optimal sites, and various restrictions imposed by the site and so on. This means that any mmWave solution must be small, compact, and easy to deploy by non-skilled contractors.

3 CCS & the Solution

Founded in 2010, CCS (Cambridge Communication Systems) is a global provider of network infrastructure solutions. CCS is the creator of Metnet self-organising 5G microwave access and backhaul for small cell, 5G Fixed Wireless Access (FWA), CCTV and fibre extension applications. CCS is based in Cambridge, United Kingdom. The company serves customers and partners globally, with a key presence in Asia and North America.

3.1 Metnet Solution

3.1.1 Metnet for 24~28GHz bands

CCS pioneered the concept of an interference-aware, self-organising mmWave mesh operating in the 24/26/28GHz licensed bands, with an emphasis on ease and speed of deployment, and utilising small form factor units which can be mounted at street level in dense urban areas.

Metnet has been developed to overcome the trade-offs other systems impose. It currently operates at 26 and 28GHz in licensed, area-based spectrum that's widely available in most markets. The small form factor and only one unit per lamppost easily satisfies urban planning requirements. The node's unique self-organising capability and wide 270-degree field of view enables plug-and-play installation in under 15 minutes, with no need for radio planning or manual alignment. A unique multipoint-to-multipoint architecture with self-healing links offers higher availability and resilience. And the system is easy to scale as existing nodes will automatically re-organise and re-align as new ones are added. CCS Metnet in the 26/28GHz bands has been generally available and deployed in the market for 5 years.

***Figure 1**: Metnet 28GHz pre-5G in the City of London*

3.1.2 Metnet for 60GHz band

Live deployments of Metnet in the 60GHz band will start during 2018. Metnet 60GHz uses advanced radio architecture and interference-aware 3D SON™, and delivers at least 12Gbps per node in the unlicensed band. Metnet is based on a modular architecture, meaning phased array antennas and baseband components can be evolved to support 5G-compliant air interface for access and backhaul at a much lower cost than a traditional 5G macro and core network implementation.

***Figure 2**: Metnet 60GHz Mesh Radio*

Metnet 12Gbps 60GHz mmWave is the first product release within CCS's new Software-Defined Network architecture, and is part of the evolutionary roadmap towards next-generation radio. Multiple distributed Metnet 60GHz nodes combine to provide an SDN-capable networking switch, which can be managed either through the Metnet Element Management System (EMS) or a third-party management system acting as an OpenFlow SDN controller.

Another important advantage of Metnet 60GHz is distance covered. By using silicon germanium-based (SiGe) technology, Metnet is able to achieve high EIRP (radiated power) with its phased array antennas, giving a longer range than conventional Si-based transceivers for equivalent throughputs. Moreover, the Metnet 60GHz system couples its high capacity with very low latency – significantly better latency and jitter than with a 60GHz WiGig system, and actually exceeding the requirements for next-generation radio and 5G.

3.1.3 Software-defined network and self-organising network architecture

Metnet 12Gbps is the first product release within the CCS Software-Defined Network architecture, and part of its evolutionary roadmap towards 5G next-generation radio.

With this new product, CCS is leveraging the low cost base of proven component technology and combining it with the unique Metnet self-organising mesh architecture, to deliver a vastly superior solution that guarantees end-to-end capacity and quality of service, and resolves the issues around point-to-point network alternatives.

Metnet's coordinated, 3D SON™ interference-aware technology and ability to organically scale makes it a truly ideal solution for new entrants looking to take advantage of the exciting unlicensed 60GHz and 3.5GHz shared spectrum opportunity. For existing mobile operators, Metnet 12Gbps provides a robust and futureproof platform for network densification via small cells and, ultimately, the wide scale roll-out of 5G.

3.1.4 Enabling neutral host model

Metnet's ability to manage multiple services and delivery high capacity and carrier grade QoS can be used to enable neutral host transport and service models. The 60GHz unlicensed radios liberate the neutral host from acquiring spectrum, and can be deployed at street level to extend dark fibre to the edge of the network. Neutral host providers can then offer a fibre-like transport service combining both physical asset and backhaul transport for multiple operators and other smart city applications such as Wi-Fi and CCTV backhaul.

3.2 Applying the solution to the mobile network

It is relatively easy to apply CCS's Metnet solution to the mobile network. In the case of the Telefónica UK City of London deployment, the network was operational within just 13 weeks. The time from CTIL/TEF signing the contract with City of London to live deployment of 141 sites was 28 weeks, which demonstrates just how quickly the solution can be planned and deployed.

The CCS Metnet radios are designed to be deployed in under 15 minutes with minimal skill and no alignment. A typical site consisting of a CCS radio and small cell could be operational in under 2 hours. The system is easy to scale as existing nodes will automatically re-organise and re-align as new ones are added.

The investment required for a deployment is typically driven by the cost of the radio, or cost per radio link. A management server would be required for operational activities, together with the cost of the software. Ongoing support and maintenance can be added as required. The cost of a deployment would also include the site rental, cables and accessories, and the cost of spectrum if operating in the licensed bands. The solution is particularly effective in a dense urban or dense suburban deployment scenario.

3.3 Key differentiation points of Metnet

- **Enables neutral host model:** the network infrastructure can also be leased to other interested parties to create additional revenue and to indirectly share costs
- **Is easy to deploy and operate:** Wireless radio nodes can be deployed without expertise quickly, and the overall network infrastructure can be integrated into an existing network in relatively short time
- **Adapts to changing environment:** Self-organising and self-healing capabilities make the network adaptable to the changing environment, rather than having to schedule maintenance work and disrupt the operational network

- **Can be applied to fixed applications:** In addition to providing connectivity to cellular base stations, the solution can replace fixed lines and provide Fixed Wireless access, opening up new use cases for the network to leverage
- **Paves the road to software-based network infrastructure:** The software-based network solution prepares for the 5G era, where the overall network is expected to be softwarised

4 Economic benefits

The CCS Metnet solution can bring both investment rationalisation and cost sharing effects. Furthermore, it also creates new revenue opportunities by providing Fixed Wireless Access and replacing existing fibre applications.

4.1 Investment rationalisation

As a uniquely self-organising wireless mesh network, Metnet requires 50% fewer radios and 1/3 the deployment time compared to classical PtP (Point-to-Point) wireless network deployment. This leads to a significant overall CapEx savings (with equipment, installation, RF planning and site fees all reduced). In terms of OpEx, reductions in site leasing, power, support, ongoing RF planning and optimisation resulting in positive savings when compared to classical PtP deployments.

Although details depend on the operators' specific business models and the revenues being generated, the network investment can be recovered within 1-2 years after deployment.

4.2 Cost sharing via neutral host

Costs can be significantly reduced when physical assets and transport networks are shared by multiple network operators or service providers. The owners of the physical assets such as City municipalities can benefit by having their assets managed by a single entity, and the reduction in the number of radio devices required and the disruption caused by deploying multiple wireline services. Mobile operators will also experience improved economics by sharing or outsourcing locations and leasing transport services from a service provider, rather than having to design, procure, and deploy solutions, together with ongoing operational costs.

4.3 Potential revenue creation opportunities

The Metnet solution can be used for both backhaul and Fixed Wireless Access applications. Backhaul includes Wi-Fi hot spots, 4G/5G small-cells, DSLAM/G.Fast, and CCTV. Access applications span both enterprise and, in some cases, residential connectivity. This means that it is possible to replace existing fixed infrastructure with Metnet's superior performance, and therefore unlock new revenue streams by providing applications based on significantly improved quality.

4.4 Testimonials by CCS customers

This section quotes the testimonials of the CCS customers verbatim for information of the interested readers.

“CCS Metnet was really ground-breaking, because it took all of the data that was being backhauled over the 5GHz spectrum and used the completely separate 28GHz spectrum, which meant all of the spectrum interference issues went away, leaving us with an open channel for public access Wi-Fi.”

- Steven Bage, Strategic Infrastructure Advisor for the City of London Corporation

“With 10 million visitors passing through the Square Mile every year, the need for a better public Wi-Fi service in the area was clear. With this next-generation small cell network now live and delivering high-speed wireless service across the Square Mile, the results have been obvious and immediate. The backhaul service provided by CCS Metnet has been absolutely key to this project, overcoming the technical and operational challenges of deployment and delivering on the promise of high-speed wireless data services for users.”

- Derek McManus COO, Telefónica O2

“CCS, as the world’s first creator of self-organizing 24GHz broadband backhaul and transport systems, provides FiberTower with a low-profile, easy to deploy, multipoint-to-multipoint solution capable of half-gigabit throughput,” said Joseph Sandri, FiberTower co-president. “It provides our customers with carrier-grade broadband signal up to 2km from each unit.”

- FiberTower (Acquired by AT&T)

"M1 is committed to delivering the best experience to customers attending the F1, where demand for mobile data is always extremely high. The powerful combination of M1’s small cell network and CCS’ industry-leading Metnet system enabled our customers to share the exhilaration of their F1 experience through social media on M1’s advanced 4G+ network.”

- Mr Patrick Scodeller, Chief Operating Officer, M1 Singapore

“A live deployment in downtown Tokyo is the ultimate challenge for a small cell backhaul system. Our engineering team was impressed with Metnet’s unique MPtMP mesh architecture and approach, and we wanted to test how this self-organising, self-optimising, and self-healing microwave solution performed in a dense urban area.

We designed the trial principally to assess Metnet’s automatic support for NLOS, and its ability to cope with multiple RF paths in a multipath propagation environment – all while delivering optimal performance and quality of service. Metnet’s capabilities fulfilled our expectations. The trial has provided a valuable insight into the behaviour of microwave and mmWave systems in future 5G bands, and the results of our trial demonstrate that Metnet can be well positioned to support these fifth generation networks.”

- Tomohiko Furutani, Technology Strategy Office, Softbank Japan

5 Implementing Metnet in the City of London

NOTE: This section summarises another case study by CCS – or details please click here.

The City of London has already implemented Metnet solution to cost-effectively provide better connectivity to Wi-Fi hotspots and 4G small cells situated in this key global financial centre in London. This section will describe the project in London to illustrate benefits of Metnet.

5.1 Market context

The “Square Mile” accommodates a huge number of mobile users, with more than 400,000 workers passing through its streets each day and 10 million visitors each year, alongside a resident population of around 9,000. With co-existence of historic architecture and contemporary buildings, the mobile networks have had numerous mobile black-spots across the Square Mile. Furthermore, the original public Wi-Fi network deployed nearly 10 years ago was poor in coverage and performance, with Wi-Fi backhaul that was prone to interference.

5.2 The neutral host infrastructure deployment project

5.2.1 Plan

The City of London announced plans to improve its wireless connectivity in the Square Mile in April 2017. The network plan covers improving the coverage and capacity of Wi-Fi and 4G small cells. The City of London offered around 3,000 street assets for use in a public tender to deliver the plan, but asked for the creation of a free-to-access, next-generation Wi-Fi network and backhaul networks in return. It also required that the backhaul system deployed must be neutral host and open to all service providers.

5.2.2 Key considerations

The neutral host backhaul of the new network is built on CCS Metnet operating in the licensed 28GHz band (area-based). This was the result of three key requirements by the City of London Corporation.

Firstly, the solution had to ensure minimal disruption. Significant civil work is impractical in this busy urban area, as there were no accurate maps of underground infrastructure and activity levels were high. Therefore, a wireless solution was pragmatic.

Secondly, the City of London was very sensitive to the appearance of equipment on street furniture in terms of both size and number. This meant that radio nodes with small form factor and wide coverage was pragmatic (Metnet’s solution offers 270-degree field of view in a small form factor radio node).

Finally, the cost associated with the network had to be feasible. Without feasibility, the project would not be sustainable and would incur financial burdens on the municipal government. The Metnet solution offered simple, low-cost, scalable installation that provides superior performance (capacity, latency and availability), which amply met the City of London’s criteria.

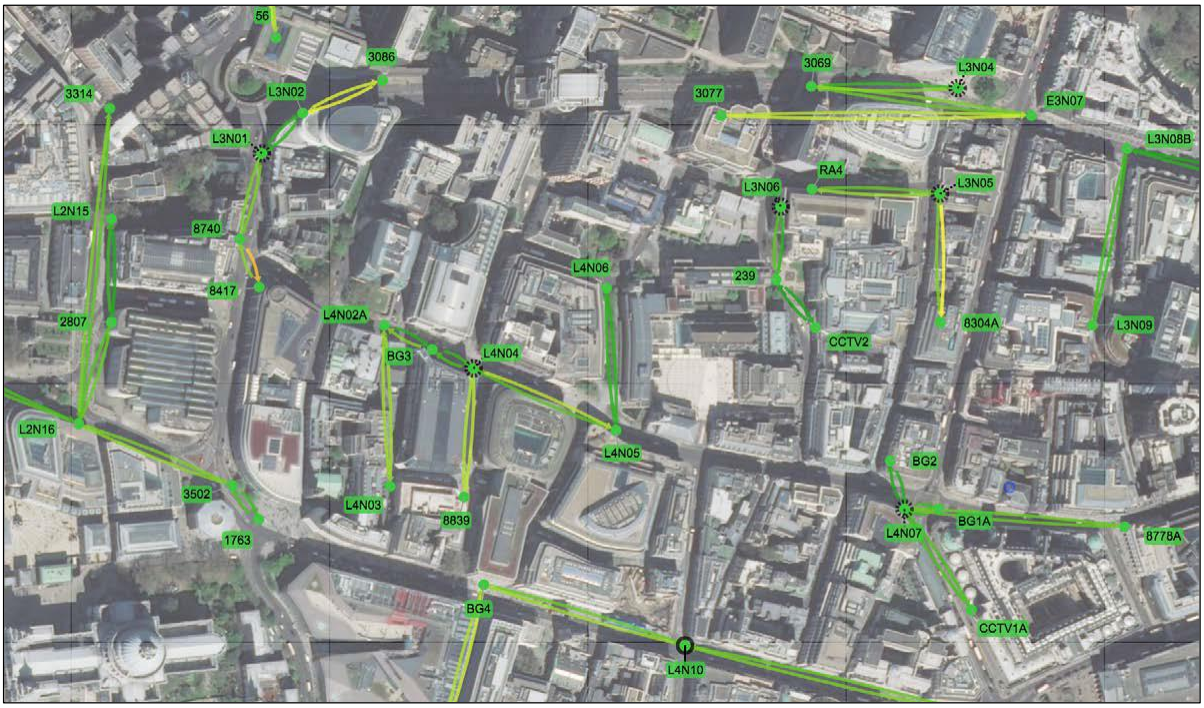

***Figure 3** CCS view of deployed backhaul network*

5.3 Metnet Network siting – challenges and resolutions

Approximately 3,600 street-level sites were available for the deployment, including 122 sites used for the original public Wi-Fi network. The deployment team focused first on finding fibre-connected sites and then in-filling with CCS Metnet node locations to link back to the fibre and create the wireless mesh.

Given the complexity of the environment, CCS conducted site audits in conjunction with the partner companies in the deployment. This entailed simple visual checks to confirm line of sight (LOS), rather than using lasers or telescopes.

With construction work ongoing in the Square Mile, and scaffolding regularly going up and down, LOS could potentially be disrupted later on. Therefore, the ability to flexibly adapt the backhaul network to the environment was crucial to overcome these changing conditions.

Additionally, there was a requirement to overcome the issues of multi-path and jamming signals and robust GPS-derived timing. CCS Metnet overcame these issues by using its distributed GPS feature to share the synchronisation between nodes, delivering accurate frequency and phase to the small cell devices.

To minimise disruption, equipment was attached using cherry pickers outside of business hours, and electrical termination was completed during the day. A two-person crew took only two hours on average to install both the Wi-Fi access point and Metnet backhaul node at each site. The Metnet node is installed above the Wi-Fi access point to ensure the best possible connectivity between sites.

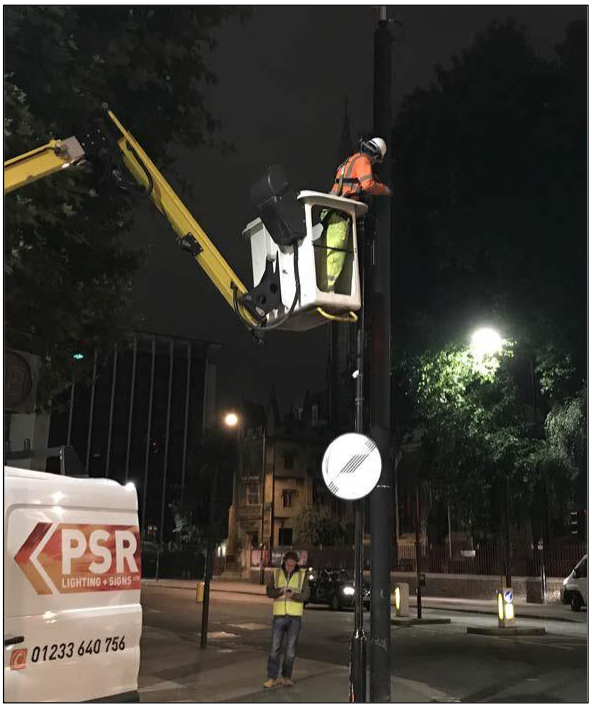

***Figure 4**: Night-time installation of CCS Metnet nodes*

5.4 Milestones and future plans

Following the initial plan announcement in April 2017, the network formally went live in October 2017, offering the fastest free-to-use public Wi-Fi in the UK. The installation of the new high-speed service was completed in just 28 weeks from start to finish. Uptake of the new service has been high, with consistently positive feedback from users.

Phase Two of the deployment went live from the beginning of 2018, with Nokia Flexi Zone small cells added on some sites to densify O2's 4G network. Over 50 small cells have been deployed in the initial phase, successfully boosting coverage and capacity in key areas. More installations are planned by the end of 2018.

6 Lessons Learned

From the case of CCS's Metnet solution, it is apparent that a self-organising wireless mesh network solution enabling neutral host can benefit operators by delivering investment rationalisation and revenue creation opportunities. This is possible through cost-effective deployment and operation of the wireless network, with indirect cost sharing via neutral host.

This means that, while the specifics depend on the operators' specific business models and revenues, the investment will be covered within 1-2 years of deployment.

Metnet provides backhaul for small cells, and also for the purpose of Fixed Wireless Access, CCTV and other fibre extension applications available in the market. This creates additional streams.

Metnet is commercially available and is already installed in the City of London and major markets in Asia and North America. The key differentiation points of the solution that make Metnet attractive are listed below:

- **Enables neutral host model:** The network infrastructure can also be leased to other interested parties to create additional revenue and to indirectly share cost.
- **Easy to deploy and operate:** Wireless radio nodes can be deployed quickly, without expertise, and the overall network infrastructure can be integrated into the existing network in relatively short time.
- **Adapts to changing environment:** Self-organising and self-healing capabilities make the network adaptable to the changing environment, rather than having to schedule maintenance work and disrupt the operational network.
- **Can be applied to fixed applications:** In addition to providing connectivity to cellular base stations, the solution can replace fixed lines and provide Fixed Wireless Access, opening up new use cases for the network to leverage.
- **Paves the road to software-based network infrastructure:** The software-based network solution prepares for the 5G era, where the overall network is expected to be softwarised.

7 Summary

CCS's unique capability is serving one of the world's most demanding and data-heavy networks in one of the most complex urban environments. The foundations have been laid for the cost-effective self-organising wireless transmission solution to be provided as neutral host infrastructure.

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