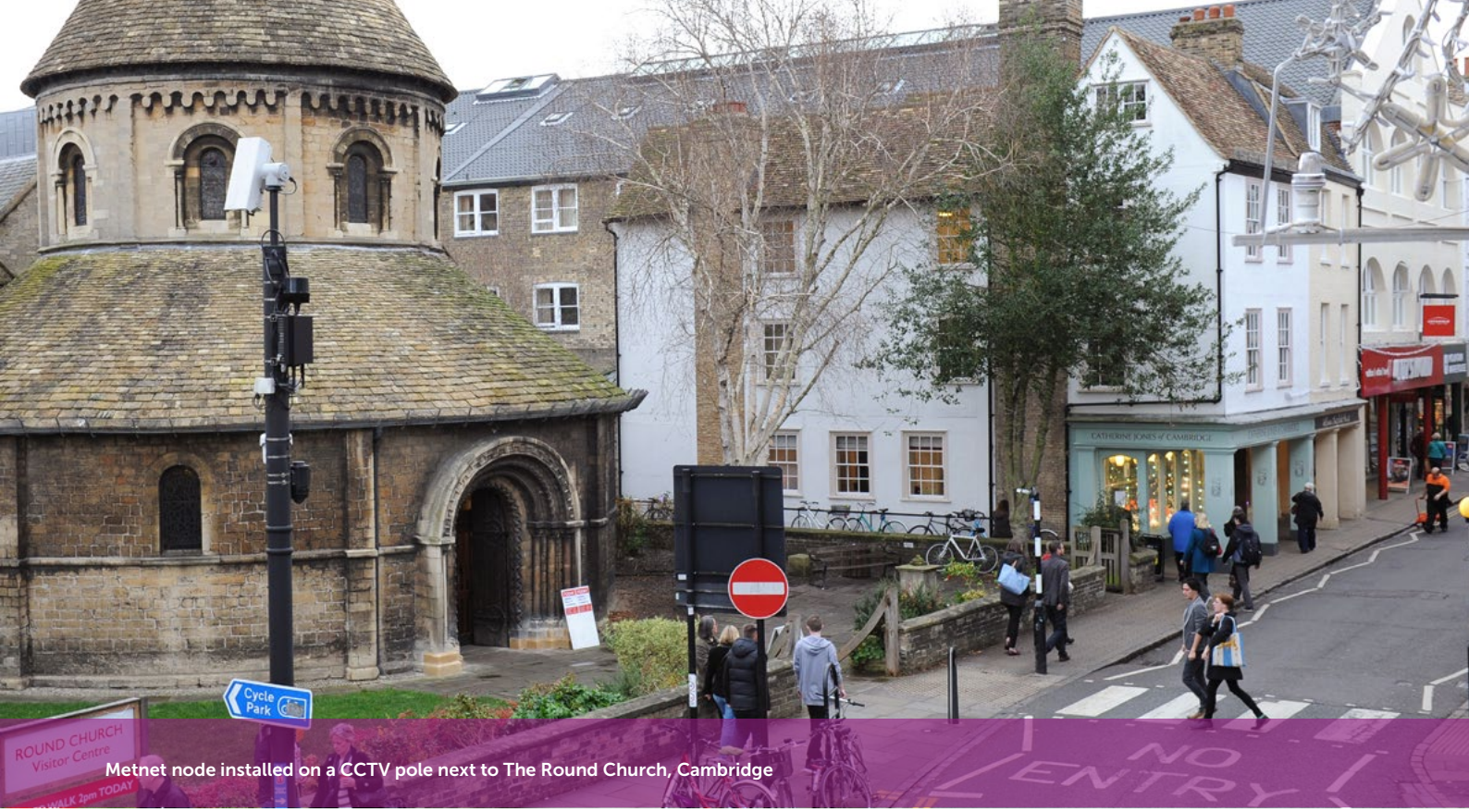
CCS

Making the urban small cell happen

The long-awaited rollout of urban small cells is finally starting to happen. But the deployment challenges mean that a flexible approach to backhaul is essential. We share some of our experiences with Metnet – a self-organising, multipoint-to-multipoint microwave solution – and the need to work around an environment and sites that are often not ideal.



Metnet node installed on a CCTV pole next to The Round Church, Cambridge

Fail planning, plan to fail

The biggest challenge – and cost – in urban small cell deployment today remains site acquisition and associated planning approvals. Our experience in Cambridge has been no different, compounded by the large number of listed buildings in the historic city centre, which makes it a 'conservation area' in planning terms.

The local council, however, is highly supportive of smart city projects and currently does not charge any attachment fees. The Metnet backhaul node is small enough to fall below the planning threshold and only one unit is required per location. But the addition of a separate small cell unit was not permitted on lampposts as this exceeded the limit for a single 8kg attachment set by the council's contractor responsible for lamppost replacement and maintenance. The lamppost diameter was not considered wide enough to accommodate a heavier load and finding alternative sites added significant delay to the process.

In other parts of the world, planning approvals can be less of an issue. The process of site acquisition for our first deployment in Beijing consisted of a single two-hour meeting between CCS, the small cell vendor and a representative from the local municipality. We walked through the deployment area, pointing out which sites were required and approval was given at the end of the meeting. Installation proceeded the next day.

Similarly, we were able to deploy a small trial network in Cape Town, to provide additional capacity during the Africacom tradeshow, in only 10 days – including network planning, site acquisition, installation, integration and test. It is likely that more difficult planning experiences will outweigh the easier ones, however, and a small, discreet installation is key to removing the obstacles.

The deployment area in Wangfujing Street, Beijing

Making second-best sites viable

There are limited sites available for most small cell deployments and they're often not ideal from a radio planning perspective. The environment presents a number of challenges, with LOS (line of sight) issues and unpredictable multipath interference in dense urban canyons.

We experienced a lot of site churn during the network planning process in Cambridge, as different options were considered with different site owners and multiple stakeholders within the council and its contractor companies, the small cell vendor, mobile operator and its managed service provider.

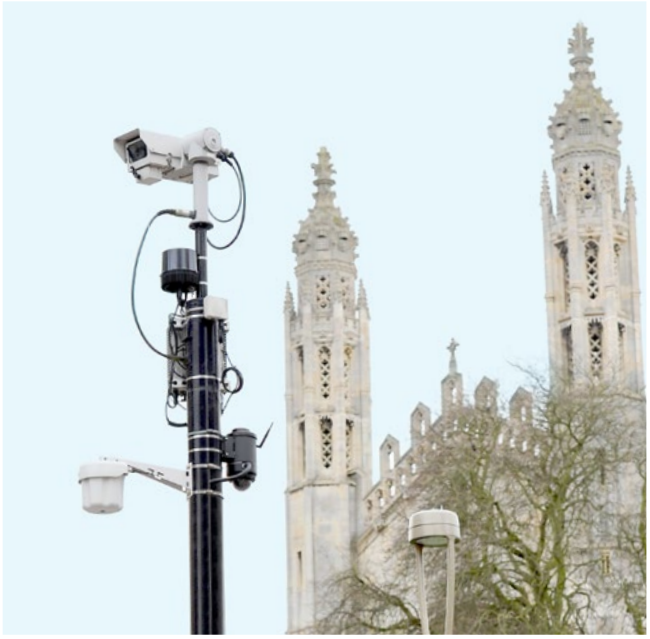
Since lampposts were eventually ruled out, CCTV poles were agreed as an alternative because they were wider and could accommodate multiple, heavy attachments. In this case, they were already populated with two CCTV cameras and a public WiFi access point.

While there are less planning restrictions for CCTV poles, they are shorter – 6 metres compared to 8-metre lampposts – and fewer in number. This made LOS more challenging, with a number of links required over 200 metres around gently curving streets.

Metnet is a microwave solution operating at 26 and 28GHz currently. Each node delivers a wide 270-degree field of view, which generates a high number of viable connections between nodes. This provides far more flexibility.

The system's self-organisation sequence first identifies all possible links between nodes, and then selects the strongest ones for active traffic links. It cycles through this process continuously, adapting to any changes in the traffic load, interference environment or LOS conditions.

It is this self-organising capability with support for multiple connections that enables Metnet to operate on some NLOS links – up to 350 metres in the case of our Cape Town trial – and provide the flexibility required to make second-best sites viable.



Installation on CCTV pole

Metnet EMS view of Cambridge deployment showing all possible antenna-to-antenna combinations

Metnet node temporarily installed behind a window.

Best-laid deployment plans need to flex

Limited availability of sites in a challenging deployment environment means that a degree of experimentation is often necessary during the installation process with sites that have not been radio planned – which clearly has significant cost implications for larger deployments.

This was certainly the case for our Beijing deployment, where it was impossible to predict how the radio signal would propagate in dense urban canyons with highly reflective buildings that produced lots of multipath interference, and how this would affect other parts of the network. Metnet was able to self-optimise based on all possible links, and uses a Spatial-TDMA schedule to dynamically manage multipath interference.

Metnet deployment in Beijing

This deployment also included rooftop sites, with steep drops to the street-level ones. This led CCS to develop a high gain variant of its Metnet node with a directional antenna, specifically for these types of link.

In Cambridge, some sites were not available immediately, including one lamppost where we were contending for space with Christmas lights on display at the time of deployment. As a temporary solution, the small cell and Metnet backhaul node were installed behind the window of a nearby retail outlet, which created a NLOS link via building reflection. The intention is to relocate to the outdoor site at a later stage. Since it only took around 45 minutes to install both units, it will be a simple task to redeploy.

This type of ad hoc, agile deployment is essential for small cells – both during the initial installation phase and when the network needs to expand. By eliminating the need for radio planning and manual antenna alignment, Metnet handles deployment uncertainties far more easily and efficiently. Self-organisation and support for multiple connections underpin its ability to instantly change topology, enabling rapid, flexible deployment.

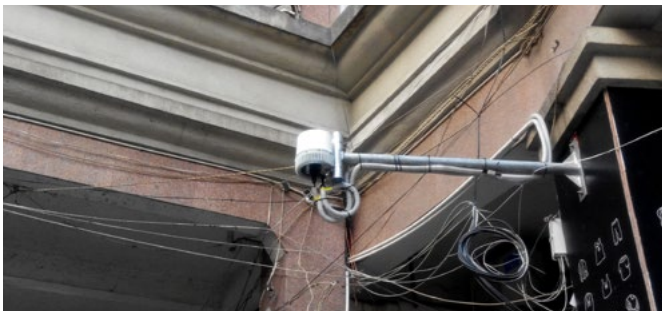
Achieving resilient synchronisation

Tight timing synchronisation is fundamental to mobile network performance, to ensure seamless handover between the small cell and macro cell layer, minimise interference and deliver maximum capacity.

Two sources of synchronisation are typically preferred to ensure resilience and high availability. Where accurate frequency and phase timing (1588v2 and SyncE) are not available through the network, then GPS is necessary to provide a local source of synchronisation.

This is more easily achieved in urban areas for macro cells, where antennas are located on rooftops. For small cells, it's much more challenging down at street level and it's usually not feasible to extend a GPS antenna up to a roof – either practically or cost-effectively.

The environment for CCS' deployment in the Chinese province of Fujian – narrow streets with densely-packed tall buildings and a limited view of the sky – is one of the most challenging we've encountered for issues with LOS, multipath and GPS.



Metnet deployment in Fujian, China

Each Metnet backhaul node has an integrated GPS antenna, which is able to provide a source of local master synchronisation to the small cell.

Distributed timing recovery provided further resilience. Only one Metnet node needed to 'see' the sky and could pass timing to the rest of the small cell network. The node's wide 270-degree field of view generates multiple viable links, which effectively provides more opportunities to deliver and accept timing signals.

This enabled operation in a more challenging environment like Fujian – which seems to be the rule rather than the exception for most small cell deployments – where the small cell's own GPS may fail.

Flexibility is key

The most important lesson from CCS' small cell deployment experience to date is the need to be flexible. And the key challenge for backhaul systems is how to deliver that flexibility quickly at low cost. Each deployment presents its own issues and these must be overcome to enable agile, ad hoc rollout, with the ability to quickly change topologies without a cumbersome planning exercise. This becomes even more critical as the network needs to scale.

Speak to our team today

If you'd like more information on this subject or CCS products, please don't hesitate to contact our team **www.ccsl.com/contact**

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