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MARKET UPDATE

// SMALL CELLS 2020

Making sense  
of the world's  
mobile networks

5G, Virtualisation, Open RAN,  
Private Networks

# Small Cells Market Update

INCLUDES // SCF Small Cell Awards 2020 // THE WINNERS

# Small Cells Market Update

## SPONSOR'S FOREWORD

### // Delivering on the small cell promise

The global situation with Covid-19 in 2020 meant that the operators, developers, vendors and other players in the small cells ecosystem were unable to meet in 2020.

Picocom is therefore delighted to be Gold Sponsor of TMN's Small Cells Market Update, a publication endorsed by Small Cells Forum that brings together much of the recent data and news from the sector.

This Market Update shows how network operator priorities have continued to drive the importance of small cells to the mobile network mix. The first 5G commercial networks are live, and focus is switching to how to provide coverage indoors, to deliver bespoke private networks, and to establish deployment, ownership and operating business models that make economic sense.

There's also a growing awareness that it is in industrial and enterprise markets that operators can truly monetise the advanced capabilities that 5G brings. Finally, 2020 has really seen the Open RAN movement break through to a wider understanding of the benefits it may bring.

The development, manufacture, deployment and operation of small cells helps operators meet all these strategic goals, and Picocom is excited to support the industry as it takes those steps, from defining open interfaces for 5G small cells, to developing open standards-based technology to create a truly diverse small cells ecosystem.

We also welcome the innovation and commitment to delivering on the promise and potential of 5G that we see in the pages of this Small Cells Market Update.

Oliver Davies,  
VP Marketing

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EDITOR

Hi!

Through 2020, we have taken a different path to the one that usually delivers us to the familiar landmarks of the year.

One such landmark, mid-year, is the Small Cells World Summit and its Awards. These events act as an annual update and re-set on what is happening in the development and deployment of small cells. But with the delay of Small Cells World Summit, and the awards taking an online form only, 2020 has passed without its usual small cells information download.

So this Market Update works in a small way to rebalance that. It takes a look at the main trends driving small cell technology and deployments, and it casts an eye at what the main small cell developers have announced this year.

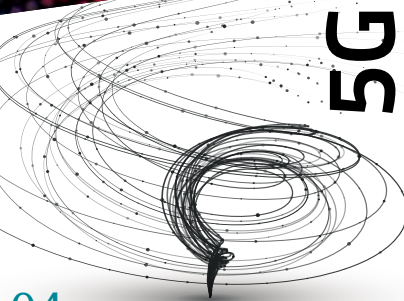
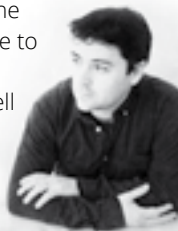
As operators seek to use 5G to inject the potential for more flexibility into the way they build and operate their networks, so small cell developers too must align with those demands. That means building small cells for a variety of deployment scenarios, in a manner that means they can be managed and operated in the same manner that operators are building their macro networks. Indoor 5G coverage, and in some cases outdoor mmWave coverage, will become a strategic asset for operators that will be led by small cell and distributed radio designs.

When it comes to the market, it has become apparent that achieving multi-operator coverage in indoor and in-building settings is still a challenge. The solutions to this are both technical and commercial. What is certain is that multi-operator deployments can make the economics of deployment easier. So that means that the technology and architecture must be able to support multi operator service.

We at TMN would like to thank Small Cell Forum for its support of this publication. We also thank the Market Update sponsor Picocom.

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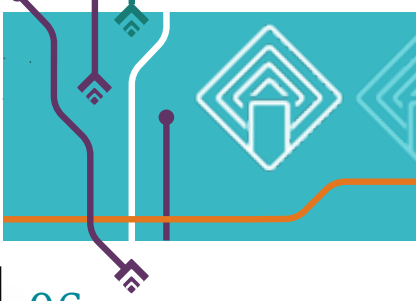
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## 5G Update

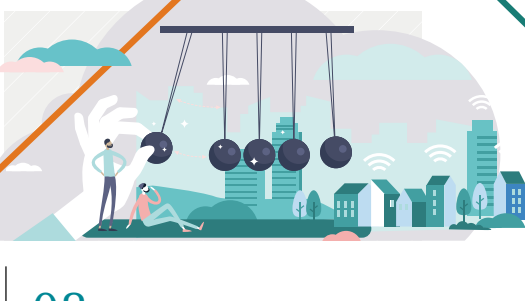
The 5G small cell may look radically different to those that came before. This article looks at how RAN disaggregation might play out.



06

## Open RAN Small Cells

Peter Claydon, President of 5G small cell chipset developer Picocom, says that the Open RAN movement aligns well with market drivers for small cells.



08

## In-building & Neutral Host

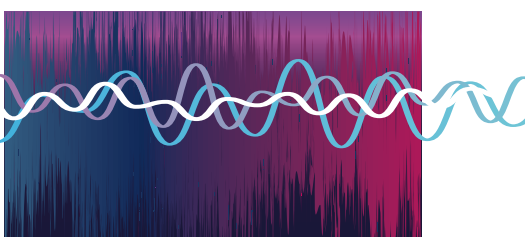
How the demand for in-building coverage, aligned with new ownership and business models, is driving the in-building market for small cells.



12

## Awards Winners & Profiles

The Small Cell Forum Awards were held virtually in 2020. We shine the spotlight on the 12 category winners, profiling the winning entries and asking winners for their reactions.



17

## Market Movers

What small cell developers and manufacturers have been working on and talking about in 2020. Pointers head towards mmWave and Open RAN, as well as more indoor solutions.



10

## Infographic

Exclusive stats and data reveals what is driving the enterprise to invest in small cells, and where the majority of indoor and enterprise small cells will be placed.



# DEFINING OPEN SMALL CELLS FOR 5G

If 2020 is a transition year for Radio Access Network technology, then that holds true for small cells too.

Small cells are not a discreet part of the wireless sector, protected from the winds that blow through the rest of the industry. They are subject to the same prevailing trends and market demands that move the market overall. In 2020, the wireless industry has been grappling with the move to 5G, enabling open, virtual and cloud-based networks, and on delivering connectivity via new ownership models. All of these, combined with geo-political winds that have also buffeted the sector, have led to Open RAN being the break-out RAN trend of 2020. Governments want to see their telco sectors have a greater choice of suppliers, so that they are not subservient to the development timelines or pricing of just two or three main network equipment providers. Mobile network operators are attracted by the dynamics of having an architecture that can enable them to deploy networks flexibly, with optimised placement of functions, and with elastic capital and operational expenditure. The disaggregation of the RAN has led, in some instances, to a re-appraisal of what a small cell looks like. Once you have Radio Units connecting to Distributed Units that in turn connect to Central Units over open interfaces, the question arises as to how you build a small cell, and how you work out which small cell architecture will best

fit the network densification or dedicated coverage you are hoping to deploy. There may also be economics considerations. For multi-operator coverage within a building, which virtualised and Open architecture will work best, enabling the addition of more capacity to dedicated solutions? The next generation of LTE and 5G small cells will need to address many new and evolving requirements. This is driving the need for new functionality in the radio due to the need to support wider bandwidths and new use cases including: enhanced Mobile Broadband, massive Machine Type Communication, and Ultra-Reliable Low-Latency Communication. Having a radio platform that can adapt and scale to support these new use cases is critical for developers. This year, a group within Small Cell Forum spent time identifying and defining the different types of small cell that sit within the disaggregated architecture defined by 3GPP. Vicky Messer, of Picocom, led much of the work within SCF, as it produced its document “5G small cell architecture and product definitions: Configurations and Specifications for companies deploying small cells 2020-2025.” She says that forming the definitions, so that the industry can be clearer about the

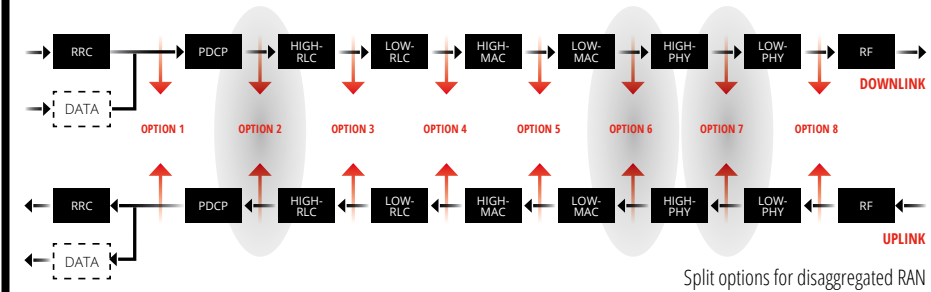
options it wants to move forward with, will help hardware developers design systems that are fit for their specific purpose and small cell architecture. That’s important in bringing solutions to market quicker, because optimising chip and hardware development to specific radio and PHY layer processing demands “is where the lead time is”. SCF’s working group, which alongside Picocom included contributors from mobile operators AT&T, BT, Reliance Jio, and industry suppliers Keima and JMA Wireless,, surveyed the industry to establish key parameters for the disaggregated Radio Unit (RU), DU (Distributed Unit) and Central Unit (CU). The aim was to give guidance on the sorts of small cell products that will be developed over the next five years. These take account of the deployment scenario, defining the architecture and therefore product parameters that would fit that deployment. Messer said the aim was to produce a “tool” for SCF members to work out scenarios based on parameters such as the number of transmitters/receivers in the product, antenna ports, the relevant MIMO layers and fronthaul bandwidth requirements. The Release defined a number of different small cell types. The first is the integrated all-in-one small cell, with the antenna and radio baseband contained in the same

physical unit, and that unit connected to the mobile core or a controller node of some sort over a backhaul connection. But even here, the internal interface between the lower (PHY) and upper (MAC) layers of the unit can be open, meaning that a product developer can assemble a product using software from different providers. The open interface for this sort of design is the SCF’s 5G-FAPI. Disaggregated small cell networks break down the constituent parts of that integrated unit into two or three functional elements, the RU, DU (these can be combined as an RU-DU) and CU. The disaggregation point is known as “**SPLIT**”. **SPLIT 2** creates a two unit solution - a CU and then a DU-RU combination using what is known as a higher layer split, with the F1 interface supported between the CU and the DU-RU. Again the 5G-FAPI interface is deployed internally in the DU. **SPLIT 6** supports a “three box” disaggregated small cell - with the constituent parts being the sRU, sDU and sCU. In this instance, the sRU and sDU support a network version of the 5G-FAPI interface k. This interface is therefore known by the SCF as 5G-nFAPi. **SPLIT 7.2** is the most commonly adopted “Open RAN” split to date because it uses the O-RAN Alliance’s Open FrontHaul interface between the oRU and the oDU. This option can be a three unit solution, or it can bundle the oCU-oDU together, interfacing to a discreet oRU. **SPLIT 8**, a very low layer split, is common in China, mostly, where there is good fibre availability for the very demanding fronthaul links that it creates. According to the SCF’s survey results, **SPLITS 6 AND 7.2** are perhaps the most important in terms of small cell volume, with the majority of respondents also preferring a two unit (ie single split) option in those cases.

Following its survey, which included asking about other factors such as power levels, frequency band support and deployment options such as the need for multi-carrier support, the Small Cell Forum then produced a categorisation of different definitions of small cell, focussing on the RU and DU elements (as the CU is often located in a centralised data centre.) It found that Remote integrated and RU small cell products generally are passive-cooled, and powered by Ethernet (PoE), fiber (PoF) or Powerline. Two and Four-layer MIMO is most popular in smaller deployments although Eight-layer MIMO is required in some larger enterprise campus, urban and private deployments, and also potentially in the longer term in other deployment. Lower frequency band products dominate. But for higher frequency bands, **SPLIT 7.2** O-RU support is planned for outdoor campus, urban and private networks, with the Split 6 S-RU with support for 5G-nFAPi planned for indoor enterprise use cases.

These definitions will certainly be of note to those driving the chip level systems that support small cell units. As well as Picocom, Qualcomm has in 2020 announced that it will be developing chipset support of open RU and DUs, alongside its existing product for integrated small cell units. Xilinx and Texas Instruments are also working to develop digital front-end (DFE) solutions to increase the energy efficiency of small cells. “Even for low-power small cell applications, the PA consumes over 50% of the power of a typical next-generation radio and is therefore key to driving the OPEX and CAPEX,” said Liam Madden, executive vice president and general manager, Wired and Wireless Group at Xilinx. As an example of the sort of product the industry is targeting, Xilinx is demonstrating a small cell 4T4R radio solution that can cover bandwidth requirements up to 200MHz for LTE and 5G. 2021 will see development of such solutions, from a wider variety of players, OEMs and developers in the market.

## UNDERSTANDING “SPLITS”



A “split” in a mobile baseband defines how the operating stack functionality, previously integrated, is split into different functional units. The 3GPP has identified potential splits, from Split 0, which defines a completely integrated unit, through to Split 8. Splitting functional units apart creates the need for interfaces between the RU-DU-CU units.



## 7 things I know about...

### WHAT OPEN RAN MEANS FOR SMALL CELLS

WITH PETER CLAYDON, PRESIDENT, PICOCOM

Picocom is a semiconductor company that designs and markets Open RAN standard-compliant baseband SoCs and carrier-grade software products for 5G small cell infrastructure. It empowers wireless innovation by delivering class-leading technology and products, enabling its customers to compete in the rapidly evolving disaggregated telecoms RAN market. The company's first 5G Open RAN small cells SoC products are expected to be available first-half of 2021.

#### 1 THE PROBLEMS OF A CLOSED RAN ECOSYSTEM

Around 80% of the market is supplied by just three vendors - Ericsson, Nokia and Huawei. This market landscape has made mobile operators reliant on these vendors to set up and even operate networks and to dictate the pace of new features and service introductions. Even where operators have theoretical "vendor diversity", say by splitting up a network geographically between vendors, they are often limited in their ability to introduce a service because vendors implement features differently. The different parts of the network develop according to vendors' own closed, proprietary profiles.

That's where the Open RAN movement offers promise. Interoperable RAN functions from different vendors would make operators less reliant on the roadmaps of just a few suppliers. That could mean the introduction of newer, smaller companies, but it could also include the likes of some of the web scalars, for example, coming into this market.

#### 2 OPEN RAN ITSELF IS NOT WITHOUT RISKS

Even with the Open RAN movement, there is a risk it could become dominated by one or two large vendors contributing the majority of the code, or by the migration paths of just a few major network operators. Also, there are cost implications. Using COTS hardware for higher RAN processing layers is okay but not necessarily for L1 processing where commercial hardware can be expensive and power-hungry. Finally, Open RAN potentially puts a more significant system integration burden on the network operator.

#### 3 IN-BUILDING AND NEW OWNERSHIP AND SERVICE MODELS WILL DRIVE DEMAND

The nature of 5G, with operation in higher frequency bands, means that in-building coverage will become essential. Small cells will be the means to achieve that. But deploying multi-operator coverage cannot be achieved economically unless the basebands themselves can support multi-operator operation.

Open RAN also offers the ability to upgrade features to just specific

parts of a network, without requiring a massive macro-level license upgrade. For example, you wouldn't deploy URLLC capabilities across a whole network, instead prioritising specific locations such as industrial campuses. By disaggregating the base station architecture, you can upgrade networks in a more targeted way, deploying a best of breed vendor policy for a specific function.

#### 4 OPEN RAN AND THE SMALL CELL

An Open RAN small cell has support for defined open interfaces between the various "split" elements of the baseband and radio units.

Split 6 has been defined by the Small Cell Forum as nFAP - updating its FAPI interface for 5G. This split located both upper and lower layer PHY in the S-RU (small cell radio unit) and has achieved significant backing in Europe for in-building solutions.

The 7.2 split defines two splits with the higher PHY layers in the DU and the lower layers in the RU. It creates a low-cost RU and has been a popular option for development in Asia Pacific where buildings have more fibre to exploit for fronthaul between the DU and RU.

So we see these as the two primary standards. A key enabler is an open system of test equipment and test labs where interoperability and conformity can verify that a product from a vendor will work network with any other vendor.

#### 5 SILICON WILL BE KEY - COMPANIES NEED THEIR SOCS

We have seen before that the success of a technology ultimately comes down to the silicon. History is littered with examples where silicon ended up being the most important thing, as it is the thing that underpins everything else.

Arguably Nokia fell behind in 5G because of its silicon design decisions compared to Ericsson and Huawei. We are seeing that L2 and above can operate as software on standard processor architectures. But for L1, you need a different architecture. Intel's FlexRAN shows L1 on what appears to be a purely standard architecture, but any of those solutions ultimately include FPGA-accelerated offload. XEON servers cost money and burn lots of power.

#### 6 PICOCOM'S UPCOMING SOC

We will sell the products we are developing in the open market, licensing Picocom software with that. However, we will also be licensing source code so people can use it as the basis of their own differentiated offerings. Picocom is providing a competitively priced open solution that enables a variety of vendors to enter the 5G market.

The concept of our first chip is an SoC that is optimised for small cell DUs. It uses the FAPI protocol to communicate with the MAC layer and O-RAN fronthaul, based on eCPRI to connect to remote units (RUs). It can offload the entirety of the small cell PHY processing when connected directly into an ARM or Intel-based server.

Early equipment based on a combination of general-purpose processors and FPGAs are workable for trials and small-scale deployments but the cost and power consumption make them unviable in large-scale deployments. There's a real competitive advantage on cost and power from a baseband SoC, and that's our sole focus and area of expertise and heritage. Picocom is the 5G Open RAN baseband semiconductor and software specialist.

#### 7 WE KNOW OPEN RAN, AND BACK ITS SUCCESS

Picocom is active in the O-RAN fronthaul group, and very much involved in the SCF 5G FAPI and nFAP definitions as well. And in that capacity, we see many other companies that are supportive as well.

Despite some potential pitfalls, we really do believe that Open RAN can change the way people put networks together. A dedicated baseband SoC for Open RAN small cells will be a vital part of that change and enabling new vendors to enter the market.



#### ABOUT PICOCOM

It empowers wireless innovation by delivering class-leading technology and products. The company's first 5G Open RAN small cells SoC products are expected to be available first-half of 2021.

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# INDOOR MOMENTUM



**Indoor coverage, aided by new business models and more flexible technology, will be a bright spot for small cells from 2020.**

With 2020 being marked as a transition year for small cells as the sector adapts to macro trends such as virtualisation, Open RAN and 5G, one trend that looks ripe for industry expansion is the indoor space.

There are several reasons for this. First, 5G higher band frequencies that offer larger capacities and bandwidth will not easily penetrate into indoor spaces. Second, the trend for enterprise non-public or private networks, which give businesses greater control over their network and means they are not sharing or competing for resources with macro radio networks, obviously entails a requirement for dedicated indoor coverage and capacity. Third, the economics of deployment has given greater priority to ownership models that can enable multi-operator coverage, such as neutral host and shared network deployments. Finally, small cell solutions themselves are becoming more flexible, with virtualised basebands and distributed

radio units that can enable more cost-effective rollout, more flexible upgrades and the potential to apply more optimised services.

Analyst firm Mobile Experts said in its report "Small Cells 2020", that indoor small cell deployments would continue to grow strongly in 2020, despite 2020 being a transitional year overall for small cells.

The report said that the enterprise segment will be a bright spot for Small Cells, with Private LTE and Private 5G networks on the rise, new spectrum released recently in the USA, Germany, Japan, UK, and "many other key countries" considering a similar measure.

As you can see from the "Market Movers" feature in this publication, many small cell vendors are responding to the requirement to enable indoor mmWave coverage. And we have already seen, in the Market Development feature, how virtualisation and 5G platforms are driving small cell innovation.

Verizon, for example, is one T1 operator with commitments in this areas. It has said that it will move ahead with mmWave for inbuilding coverage using products from Corning and from Samsung. Both companies use the Qualcomm FSM100xx small cells chipset as the base for their designs, integrated with the mmWave RF support.

Corning (Spidercloud) is a fairly long-term provider of in-building solutions to Verizon, and its products seem to be further along the process, and are moving into live pilots. Samsung's small cells are still in Verizon's labs.

Adam Koeppe, Senior Vice President of Technology Planning and Development at Verizon, said, "By combining a private core, an indoor cell site and the MEC platform in a facility, an enterprise can have a private and secure ultra-reliable, high-speed, low-latency 5G network."

Chinese operators have invested heavily in the distributed RAN products offered by Huawei and ZTE to cover areas such as campuses, transport hubs and large buildings such as shopping malls.

Neutral host providers are taking different approaches to deploying multi-operator solutions. A provider such as DenseAir owns spectrum and deploys multi-operator small cells within that spectrum. Freshwave deploys multiple small cells within buildings to provide multi-operator coverage. Other infrastructure providers such as Arqiva and Cellnex use their facilities to provide neutral and shared hosting capabilities for operator infrastructure.

Virtualisation may enable a new class of solution, with remote, virtualised basebands being applied as required to remote radio units. BT has been working on a 3GPP Split 2 option to host vBBUs in a small number of near-edge data centres, with distributed units deployed in-buildings.

## OPTIONS FOR INDOOR CELLULAR

To enable the industry to engage with indoor deployment considerations, the Small Cell Forum produced one of its Release documents, titled Options for Indoor Cellular. The Release was supported by experts from Crown Castle, Colt and Cellnex. It outlines options for deployment from self install to single operator-installed, neutral host and private network services.

Two of the contributors to the Release, **PIERCARLO GIANNATTASIO**, Global Network Densification Principal at Cellnex Telecom and **MICHAEL FERRIS**, Senior Architect – Mobile Connectivity Solutions, Colt Technology Services, spoke to the Market Update about the release.

**WHAT IS THE MAIN PURPOSE OF THE OPTIONS FOR INDOOR CELLULAR RELEASE? WHAT INDUSTRY ISSUES IS IT ADDRESSING?**

**GIANNATTASIO:** On one side the mobile communication demand is strongly increasing and users expect mobile cellular service wherever they are with higher data throughput and seamless connectivity. On the other side the materials used in the buildings, with eco-friendly low emissivity glass and soundproof internal walls, attenuate and limit the outdoor mobile signal to have enough quality indoor. Additionally, broadband 5G will be provided in high frequencies, which increases the problem of the attenuation of the signals coming from the outdoor base stations. The cheapest and more appropriate solution is to deploy directly indoor coverage with densified and low power indoor Small Cells.

**FERRIS:** Given that about 80% of mobile traffic demand is generated indoors, yet almost all mobile coverage is obtained from outside transmitters, it shouldn't be surprising that there are many indoor places where even making a simple call is problematic. A decent indoor service is fast becoming table stakes for landlords to rent to new tenants, but many do not know what solutions are available or where to go to seek them. We are trying to change that.

**WHAT DEPLOYMENT OPTIONS DO YOU IDENTIFY AS BEING LIKELY TO DRIVE SMALL CELL DEPLOYMENTS INDOORS?**

**GIANNATTASIO:** To make it easy I would define three options. First, where the users in a specific location are using the same mobile operator and only this one, then a Small Cell from your operator is the natural choice. If you require service from more than one mobile operator, in multi-tenant offices or considering any visitor in a building, a neutral host multi-operator deployment is suggested. Finally, Private Network deployments guarantee dedicated resources for critical and dedicated business needs.

**FERRIS:** I think the most interesting option is the neutral host approach. Mobile operators have many existing priorities, so enabling new players to deploy solutions on their behalf will rapidly accelerate the creation of indoor coverage. The small cell approach lowers the cost compared to expensive DAS solutions and allows a scaling down to open up the market for smaller venues as well.

**WHAT HAS STOOD IN THE WAY OF WIDER ADOPTION OF NEUTRAL HOST DEPLOYMENTS OF IN-BUILDING SMALL CELLS?**

**GIANNATTASIO:** In the past mobile indoor coverage was funded only by Mobile Network Operators with single operator small cells, but nowadays this is sustainable only in some limited situations and a lot of venues are suffering from a lack of mobile communication capacity. A venue owner financing neutral host solutions can improve the business case and unlock the situation. On the other side technology has evolved into more digital and flexible solutions that help to reduce the TCO, with reduced power, less space consumption and an easy installation process - and this will open a new era.

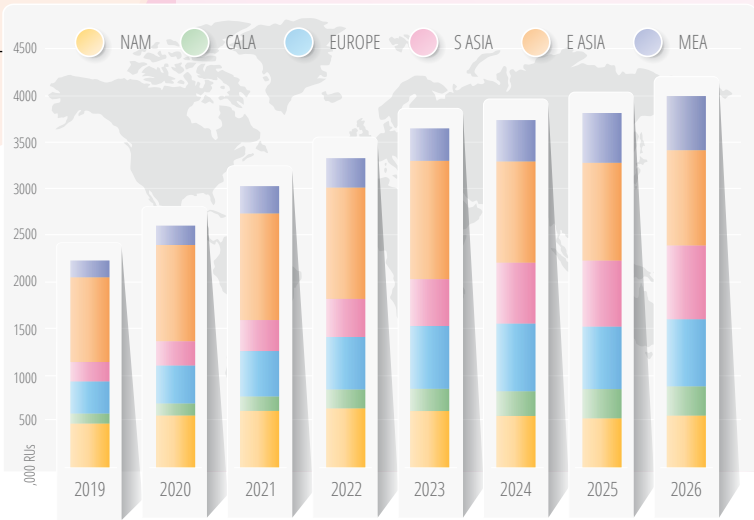
**FERRIS:** Extending your network via a neutral host throws up some additional challenges, in terms of securing the core network towards an untrusted domain and having enough control over the SLAs, since end users just see coverage from their MNO; they don't know the venue and the neutral host are involved. That's why it's not happened sooner and it's where the UK operators are breaking new ground with their JOTS initiative. Other markets will follow.



# ENTERPRISE SMALL CELLS

## ----- THE DATA

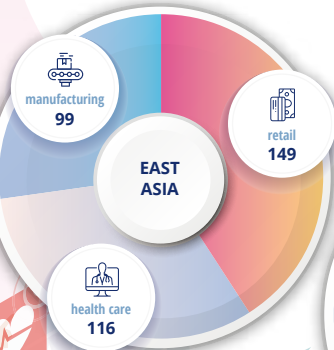
Enterprises are driving a massive small cells opportunity



### HOW MANY ENTERPRISE SMALL CELLS?

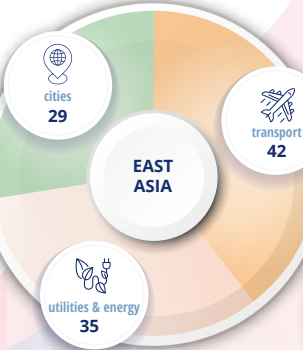
#### WHO IS DRIVING ENTERPRISE SMALL CELLS?

Top three verticals driving deployment of enterprise indoor small cells by alternative operators in leading regions

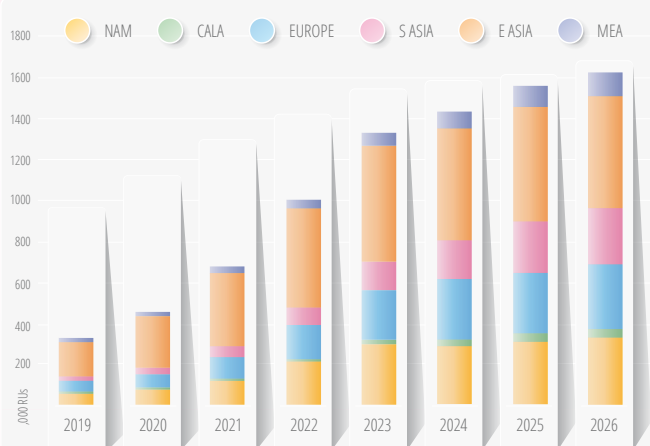


#### WHO IS DRIVING SMALL CELLS OUTDOORS?

Top three verticals driving deployment of outdoor small cells by alternative operators in leading regions

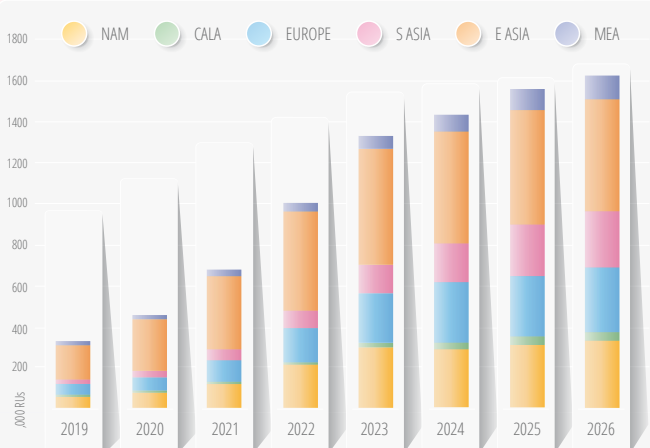


### ENTERPRISE INDOOR SMALL CELL DEPLOYMENTS BY ALTERNATIVE OPERATORS. INDOORS...

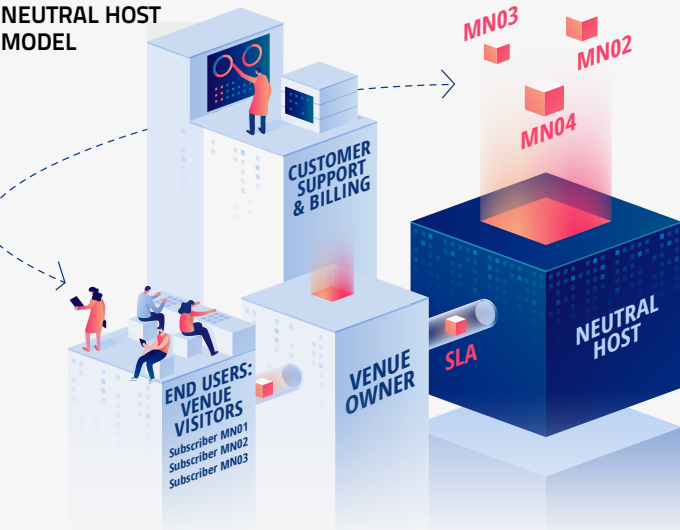


To unlock this opportunity, new ownership models are emerging, both indoors and outdoors. In Europe enterprise environments will account for 20% of the non-MNO installed base.

#### AND OUTDOORS...



#### NEUTRAL HOST MODEL



#### MOBILE NETWORK OPERATORS NEED TO MOVE FAST TO COMPETE. THAT MEANS:

- Engaging with technical solutions, such as Open RAN small cells, that enable flexible deployment options
- Considering the best path to indoor performance relevant to the customer use case
- Exploring infrastructure sharing and shared spectrum options
- Engaging with neutral host operators, as well as building owners
- Pressing for regulatory changes on siting rules
- Developing closer ties to end user business communities

In association with Picocom



Data exclusively provided to Small Cell Forum Update by Small Cells Forum





## SCF SMALL CELL AWARDS THE WINNERS

With Covid-19 restrictions, Small Cell Forum was unable to hold its annual awards event this year, but the Awards still went ahead. Here are the winning entries.



### EXCELLENCE IN COMMERCIAL DEPLOYMENT (URBAN)

**WINNER AIRSPAN & RELIANCE JIO**  
India's Largest Small Cell Deployment

Airspan and Reliance Jio won this category for their deployment of hundreds of thousands of outdoor small cells in India. The deployment helped the growing mobile operator acquire 300 million LTE subscribers in record time, whilst handling an unprecedented rate of data adoption and usage. Reliance Jio deployed its JioSON software, a previous SCF Awards winner, to automate management and optimisation of its RAN.

### EXCELLENCE IN COMMERCIAL DEPLOYMENT (ENTERPRISE)

**WINNER CORNING & DRUID SOFTWARE** Small Cells Supporting Better Healthcare

Druid Software and Corning won with their deployment of a private LTE small cell network in a major healthcare facility in The Netherlands. It thinks the deployment could serve as a model for the future.

A network of 28 Corning small cells covered 137 units housing 650 residents and staff. Druid Software's private EPC handles dedicated voice, messaging, data and an integrated IoT healthcare gateway for 115 private subscribers. Fire safety and nurse alarm calls were also integrated with the 4G private network.

The private 4G solution operates in its own dedicated wireless network frequency, the small cell infrastructure providing dedicated QoS (Quality of Service) with AES encryption.

The deployment cost, comparable to a WiFi installation, has shown its ROI in less than a year.

Tadhg Kenny, Senior Vice-president, Head of verticals solutions, Druid Software, says, "It's a great testimony to the team involved in winning this award: Druid's Raemis 5G & 4G private network platform supporting cloud native healthcare enterprise slicing. Avics' industry leading nurse call technology, CapX's Value added Distribution Service and Corning's carrier grade small cells."

Michelle Engarto, Vice-president, Wireless solutions, Product Line Management, Corning, says, "We are very proud of the recognition by the industry of the importance of a reliable and affordable in-building wireless coverage solution for all enterprises. This award won in partnership with Druid Software shows how small cells are a critical part of high performance networks, today and tomorrow."

### EXCELLENCE IN COMMERCIAL DEPLOYMENT (RURAL)

**WINNER TELET RESEARCH** Chalke Valley Project: Rural Coverage Using 5G Standalone

The Chalke Valley is the largest contiguous inland not-spot in the UK. It's difficult to serve as it is an area of outstanding natural beauty unsuitable for large masts. Through innovative use of small cells and a mesh network the winning project, initially a community scheme, installed five small cells under a test and development licence. It was then rolled out as a commercial project backed by the UK government's Rural Connected Communities programme. Up to seventy small cells will be connected by a wireless mesh. There will be limited 2G support along with, initially 4G support moving to 5G in "Standalone" mode.

The system also incorporates a push-to-talk service running in a server at the edge of the network to allow farmers to co-ordinate their workforce. The project is working to install small cells, backhaul and spectrum for several local farms. One application will be remotely controlled and autonomous combine harvesters.

While small cells are usually seen as a solution for dense urban areas, the Telet Research MONEH project demonstrates how the very latest technologies can be used in an innovative way to engage and support rural areas.

### DEVELOPMENT OF NEW ARCHITECTURE

**WINNER ACCELLERAN** Architecture-Agnostic xApps-Enabled dRAX Intelligent RAN Controller

This award recognises Accelleran's work to enable an Open RAN ecosystem within the small cell environment.

The dRAX Open Interface RAN Intelligence enables delivery of a multi-vendor, disaggregated and virtualised 4G/5G RAN Intelligent Control Plane, hosting the deployment of Accelleran and 3rd-party xApps to enable ML/AI-driven RAN algorithms.

Designed to enable an O-RAN aligned vRAN, the dRAX platform decouples user and control planes, and provides support for 3rd party Distributed and Radio Units, encouraging an open disaggregated ecosystem to bring innovative 4G/5G products to commercial market at low price points.

The lightweight dRAX components are cloud-native VNFs, available as containers (Docker for Kubernetes) and VMs (Openstack).

dRAX together with Accelleran Radio Units can also enable Open Networking Foundation's Aether reference architecture.

dRAX sits at the Edge of the ONF's Aether architecture, implementing vRAN CU functions, controlling a cluster of Radio Units.

The cities of Barcelona, Bristol and Lucca are hosting real-world trials of the technology, and BT is using dRAX and Accelleran RUs in its TIP Community Lab to demonstrate the application of AI for RAN optimisation.

Frederic Van Durme, CEO, says: "The real promise of Open RAN is to introduce best-of-breed componentry in all functions of a disaggregated RAN. Accelleran has been pioneering this view without compromise for many years. Being recognised by SCF for enabling this future architecture is an encouragement but foremost a confirmation that the RAN space is opening to a more software driven approach, generating innovation and value for many 5G emerging use cases."

### SOFTWARE AND SERVICES – MANAGEMENT, AUTOMATION AND ORCHESTRATION

**WINNER RANPLAN WIRELESS** Automated Cloud-Based Network Planning and Optimisation

In the 5G era there is an increasing argument to move from a traditional method of planning and optimising mobile networks in favour of automation to help optimise network performance post-deployment.

Ranplan Wireless took part in a joint collaboration with Rakuten Mobile to develop a cloud-based Network Planning Optimisation (NPO) automation platform. Ranplan's software technologies - intelligent optimisation modules, AI algorithms, advanced propagation engine, materials and components databases - are integrated within cRakuten's OSS and C-SON system to enable full automation of network operations.

Chief Technology Officer, Dr Hui Song, says, "We are extremely delighted to receive this award as it celebrates the achievements of our R&D and engineering team. The award also recognises the growing value for a comprehensive, cloud-based and open-ended solution powered by artificial intelligence to enable networks to self-regulate and so dynamically respond to on-demand consumer needs in the 5G era."

COMMERCIAL SMALL CELL DESIGN & TECHNOLOGY

**WINNER SK Telecom** Dual-Mode RF Repeater Commercialization

This award recognises the work SK Telecom did to increase 5G coverage by using an innovative repeater to extend coverage indoors and in hard to reach areas. Its 5G/4G Dual-Mode Speed Repeater and the 5G/4G/3G Triple-Mode RF repeaters support NSA mode, and are the first such commercialised repeaters in the world.

Using that experience, SK Telecom is now cooperating with Deutsche Telekom to expand operation to the EU and other countries, with the possibility to enhance coverage whilst reducing overall deployment costs. SK Telecom and Deutsche Telekom have conducted various tests with the repeater to verify its performance and effectiveness in EU. The collaboration included a customer trial in May 2020.



"DT's Claudia Nemat with the SK Telecom and Deutsche Telekom 4G/5G indoor repeater"

OUTSTANDING INNOVATION IN SMALL CELL BUSINESS CASE

**WINNER BT Wholesale** Neutral-Host, JOTS-Based, Virtualised In-Building Small Cell Solution

BT Wholesale's award is for its wholesale, multi-operator indoor small cell solution based on the virtual RAN split solution known as Split 6. Its architecture can bring four operators into just one or two radio units, connected to virtualised RAN technology.

Working alongside the UK Joint Operator Technical Specification (JOTS) BTW's multi-operator shared access in-building small cells solution is at proof of concept stage (POC) and is due to be operational 2020-2021.

Security gateways and CU functions are hosted centrally and virtually in the BT Edge-Cloud platform. Radio traffic is aggregated and front-hauled over a single transmission link. Each operators' traffic is backhauled unilaterally through a single-operator security gateway back to each of the mobile cores using BT's dedicated IP VPN mobile backhaul network.

The neutral solution prevents building owners having to install multiple solutions on a per-MNO basis, or prioritising just one operator's customers.

The vRAN software on a shared platform also makes it far more cost-effective for

any business to buy a common small cell system to provide 4G – evolving to 5G – services, connected through one to all UK MNOs.

Jamie Hayes, Mobile Network Operators Director, BT Wholesale, says, "On behalf of BT, I'm delighted to accept this award from the Small Cell Forum for Innovation in a Small Cells Business Case, building on the strong foundations of our success in outdoor small cells, initially in London and now many other towns and cities. With a 'hotel' based business model lowering cost for all operators, we turned our attention to our neutral host capabilities and in-building solutions over the last year. We look forward to a bright future to provide coverage, capacity and a great customer experience for the industry to provide innovation where people need it most. BT Wholesale is a UK pioneer for innovation in small cells and we believe has the scale, skill and market reach to assure the best architecture and business model for the industry as a collaborative, truly open access provider, embracing digital inclusion in society as well as the latest technological developments."

OUTSTANDING CONTRIBUTION TO OPEN RAN

**WINNER Radisys – Open 5G Software Seed Code Contribution**

This award recognised the work Radisys has done to accelerate the O-RAN ecosystem and enable the delivery of open APIs and open architectures for mobile operators' 5G network buildouts.

Radisys contributed its Open 5G Software Seed Code to the O-RAN Alliance's 5G NR Stack Reference Architecture. This was the first seed code contribution to this effort, seeing Radisys contribute seed code of RLC and MAC layers for the O-DU (O-RAN Distributed Unit). This O-DU seed code was integrated with other modules of O-DU in the O-RAN OSC Amber release, the first O-RAN Alliance software code release, representing a consolidated step towards O-RAN compliant Radio Access Network commercialisation.

Radisys has also contributed PDCP layer seed code in the O-CU (O-RAN Central Unit), and developed an F1 interface in the O-DU via an F1 simulator (CU end) to test the F1 interface connecting O-DU and O-CU.

The contribution is key for the O-RAN Alliance to be able to deliver a unified reference architecture across a multi-vendor ecosystem for open RAN deployments. Radisys' code will help enable the 'SDN-ization' of 5G NR access, and paves the way for seamless interoperability across radio layers from different RAN vendors. Radisys' contributions will boost the O-RAN ecosystem and enable delivery of open APIs and architectures that mobile operators can utilize to enhance 5G network rollouts while also benefiting from cost reductions and improved network efficiencies.

Radisys and O-RAN Alliance members continue to demonstrate the effectiveness of open, disaggregated RAN solutions at industry events. Multiple O-RAN demonstrations powered by Radisys' 5G NR software were showcased at MWC Shanghai, including the ones provided by O-RAN Workgroups 7 and 8 with operators China Mobile and AT&T.

Radisys and KDDI Research recently completed the world's first successful demonstration of RAN slicing involving different traffic streams with different latency requirements on a single Radio Unit (RU) connected to multiple Centralized Units/Distributed Units in a disaggregated network topology. Network slice orchestration is a central architectural construct for 5G networks, providing the flexibility to create and deploy complex service-specific network slices cost effectively.

"Radisys is honoured to have been chosen as a Small Cell Forum (SCF) Award winner in the Outstanding Contribution to Open RAN and core platforms and ecosystems category for providing our Open 5G Software Seed Code for the O-RAN Alliance's 5G NR Stack Reference Architecture," said Ganesh Shenbagaraman, Vice President of Engineering 5G Wireless R&D. "The traditional RAN, with proprietary, embedded and integrated RRU and BBU, is the most difficult part of the network to disaggregate. By contributing this code, Radisys is committed to leading the efforts to accelerate the availability of open APIs and open architectures for Open RAN 5G deployments."

OUTSTANDING INNOVATION IN SMALL CELL TECHNOLOGY

**WINNER Analog Devices** Quad-Channel, Wideband RF Transceiver Platform

The award for Analog Devices was recognition for its ADRV9026 Quad-Channel, Wideband RF Transceiver Platform. This is a small size, low power wideband RF transceiver designed for small cells. It enables O-RAN small cell designs with low system power and cost, reducing footprint and enhancing form factor flexibility.

Analog says the transceiver can halve power consumption over incumbent solutions, thereby enabling increased radio density to support a higher antenna count on a single chip. The platform supports up to 200 MHz bandwidth in bands from 650 MHz to 6 GHz. It's a single-chip FDD/TDD solution supporting 3G/4G/5G .



SMALL CELLS FOR SOCIAL, ECONOMIC OR ENVIRONMENTAL DEVELOPMENT

**WINNER** Vanu Inc- Small Cell Solutions for Off-Grid Markets

Judges recognised Vanu’s progress towards closing the digital divide by providing mobile connectivity to remote, off-grid markets that have not had opportunities to seize the economic, social and cultural advantages generated by mobile coverage.

In a recent case study involving the company’s pre-deployment analysis on behalf of a network operator in sub Saharan Africa, the operator provided five sites being considered and asked for a quote. Rather than provide a standard quote for the five sites, Vanu looked to address the fundamental challenge the operator was trying to address: how to deliver the return on the investment required to provide service to an off-

grid region. Using VanuMaps, its patent pending network analysis and planning tool, Vanu was able to provide models of the same area reflecting the potential coverage density based on tower height and output power. With VanuMaps and its OpenRAN-compliant small cell solutions, Vanu provided the operator with a model capable of achieving a gross margin of 75 percent compared to a gross margin of 5 percent for the five macro sites the operator would have generated using its traditional approach.

“We are thrilled to accept this prestigious award and honored to receive recognition from our industry colleagues,” said Andrew Beard, CEO of Vanu, Inc. “The SCF Small



Cell Award is further validation of the unique business model we’ve developed, which removes many of the barriers preventing mobile network operators from effectively serving off-grid markets. Vanu is now actively deploying low TCO cell sites and using our mapping and network planning tools to help MNOs optimise their investment in these unconnected regions – all at a time when the global pandemic has made connectivity more critical than it’s ever been.”

JUDGES’ AWARD

**WINNER** Industrial Technology Research Institute (ITRI)



For its outstanding work on network automation, and its long and fruitful partnership with the Forum in many areas from Plugfests to development and testing of technical specifications

OUTSTANDING CONTRIBUTION TO SMALL CELL FORUM ACTIVITIES

**WINNER** Vicky Messer, Picocom



For leading 5G small cell product definition and leading 5G FAPI network monitor specifications

Oliver Davies, Head of Marketing at Picocom, said, “The award is well deserved recognition of the work Vicky has contributed to the Forum over the past year. It’s a sign of the respect that Vicky has earned for her efforts.”

CHAIRS’ AWARD

**WINNER** Ganesh Shenbagaraman, Radisys

For playing an instrumental role in the development of both the 5G-nFAPI specification and management solutions for 5G-nFAPI based SCN solutions Arun Bhikshesvaran, Radisys CEO said, “We are extremely proud and excited to learn that Ganesh Shenbagaraman, Radisys’ VP of Engineering 5G Wireless R&D, is the recipient of the SCF Chair’s Award for the influential role he has played in the development of the 5G-Network Functional Application Platform Interface (nFAPI) specification and management solutions for 5G-nFAPI based Secure Converged Networking (SCN) solutions.

“We are honoured that Small Cell Forum Group Chair Prabhakar Chitrapu and so many others, have recognised the passion and tireless support Ganesh continues to demonstrate on behalf of open 5G network standards.”

# SMALL CELLS GO OPEN, MMWAVE

From new products to new deployments, the companies making headway in small cells this year.

ACCELLERAN

In 2020, Accelleran took steps to enable open network elements within the RAN. Its dRAX together with its Radio Units enable The Open Networking Foundation’s (ONF) Aether – an open source platform for delivering Enterprise 5G/LTE-Edge-Cloud-as-a-Service.

Aether provides mobile connectivity and edge cloud services for distributed enterprise networks, all provisioned and managed from a centralised cloud. Based on open source components and optimised for cloud deployments, Aether simultaneously supports deployment on licensed (4G/5G) and unlicensed (CBRS) spectrum.

At the Edge of the ONF’s Aether components sits, implementing vRAN CU functions, the Accelleran dRAX™ Intelligent Control Plane vRAN solution controlling the cluster of Radio Units.

“Aether provides connectivity and edge cloud services for distributed enterprise networks”

AIRSPAN

Airspan made news in 2020 as Japanese operator Rakuten used its mmWave small cells to build out its high band outdoor 5G network.

Airspan’s units, based on Qualcomm’s FSM100xx chip were chosen by Rakuten to provide the radio unit section of its mmWave 5G RAN.

Airspan Networks and siticom said they would be partnering to deliver 5G wireless connectivity for a wide variety of Industry 4.0 vertical use cases in Germany.

Airspan’s 5G OpenRANGE solutions are an end-to-end vRAN solution for the non-public network (NPN) market: from the Radio Hardware to the cloud-native software running on the Central and Distributed Units (CU/DUs). Small and Smart form factor radios and cloud-native software based on containers can fit the variety of use-cases within NPNs, enabling the scaling up/down resources and fast adoption of features like Network Slicing, 5G QoS, or positioning.

BAICELLS

BaiCells was another company to announce that it would be working with Qualcomm on a sub 6GH and mmWave small cell through 2020. The company, which also took investment from Qualcomm Ventures, was yet another customer for Qualcomm’s FSM100xx 5G RAN platform.

The company teamed up with the industry’s other chip giant, Intel, to explore OpenRAN architectures utilising small cells - a deployment scenario it said could be particularly well-suited for private enterprise networks. The two wanted to incorporate 3GPP R16 standards that enable URLLC communications - with a proof of concept in Industrial IoT use cases.

BENETEL

Small Cell platform developer became another radio developer going down the Open RAN route, developing an evaluation system based on the O-RAN Alliance 7.2 split between the vRU and vDU. The package includes Open Air Interface (OAI) Stack and NSA Core preconfigured on Dell servers, Benetel Radio Units (RUs) (both 4G Band 7 LTE RU and 5G Band N78), as well as all connectors, Test SIMs, and cabling required to run the system.

Benetel says its vRAN Radio Unit (RU) product family addresses the infrastructure needs of the emerging disaggregated RAN for 4G & 5G networks.

CELONA



New player Celona has come to market with LTE access points that support operation in the CBRS band. The company wraps up its SAS CBRS license with core network software and the access points, and has just secured a distribution deal with HPE Aruba as well as further funding from the likes of Qualcomm ventures. Its indoor access point can be powered over Ethernet and interface to a controller that carries out automated interference optimisation and other configuration, as well as enforcing service level parameters - which is why Celona calls it MicroSlicing. The indoor APs have 2T2R antennas, and can support up to 40MHz channel bandwidth.

COMMSCOPE

At the start of the year, CommScope announced open interfaces, virtualised RAN functions, and new radio points for its OneCell small cell solution. As well as adding 5G bands to the indoor access point, the company virtualised its baseband and added 7.2 O-RAN fronthaul support as well. The company also acquired Phluido. It told TMN, “The Phluido patents cover a wide range of intellectual property including fronthaul compression techniques and adaption techniques to adapt in real time to changes in fronthaul link quality (e.g., bandwidth, latency, packet-loss) and limited processing

CORNING (SPIDERCLOUD)

Corning said that its mmWave product had come through lab trials with Verizon, and would be moving into field test deployments in indoor locations. Corning has a large installed base of LTE in major enterprises in the US and its 5G is a companion overlay to scale for these medium to large buildings. Its mmWave product is built on the Qualcomm FSM 100xx solution. Corning and Intel announced in 2019 a strategic collaboration to deliver a virtual platform for Corning’s 5G network solutions powered by Intel Xeon Scalable processors and FlexRAN Reference Software Architecture. Corning, whose in-building cellular solution is built on the SpiderCloud product that it acquired, said that it will virtualise its baseband in a vDU and vCU (adopting the O-RAN 7.2 split) based on Intel’s XEON-based FlexRAN architecture.

resources, network synchronisation. This compliments CommScope’s O-RAN portfolio.” “We believe the acquisition of this intellectual property, combined with our OneCell patent portfolio, further solidifies CommScope’s position as an innovative indoor RAN provider,” said Matt Melester, chief technology officer for CommScope’s Venue and Campus Networks and Outdoor Wireless Networks businesses. In the courts the company won damages and an injunction against Dali Wireless, and initiated other proceedings against DAS company SOLiD. SOLiD said it would defend itself “vigorously”.

ERICSSON

Ericsson added to its distributed radio product it calls Radio Dot System with Dot 4475, a tri-band Dot (8T8R) supporting multi-band, multi-operator deployments; a new fibre solution for increased backhaul flexibility – the Hybrid Fiber IRU 1649 and the RFX 1110 (remote RFX module); and the IRU 8848 to support combined 4G and 5G deployments. KT, one of the leading South Korean service providers, has begun trialing the Radio Dot System on its commercial network. China Mobile is using the product on the Shenyang subway. Telia in Sweden says it will build and manage a dedicated local 5G-ready mobile network for mining company Boliden at Aitik, also using the Radio Dot. Meanwhile, in the USA, AT&T said it would be using Ericsson’s products to support private network build-outs based on CBRS. Ericsson’s Radio Dot and micro products would be a part of the platform that AT&T will offer the enterprises.

HUAWEI

Huawei launched the enterprise edition of its 5G LampSite: LampSite EE. With support for ultra-broadband, ultra-low latency, indoor precise location and ultra-reliability, the giant manufacturer said it is designed for smart applications in industries like manufacturing, health, transportation, and warehousing.

IP.ACCESS (MAVENIR)

One of the last independent small cell developers was bought in October 2020 by the ambitious core and radio software company Mavenir. Mavenir’s initial plans for the Cambridge, UK-based outfit was to integrate its GSM radio into Mavenir’s 4G and 5G baseband and core products. But the company also sees an opportunity in the longer term to use ip.access’ small cell capability to address the private networks opportunity, from 5G to CBRS. “Carrier-led or private enterprise-owned Private Networks will be more and more relevant in the coming 24 months. So we will really depend on and work with ip.access on this,” Mavenir’s Aniruddho Basu added. As this publication makes clear, small cells are facing the same drivers for open interface-based disaggregation as Mavenir is exploiting in the macro Open RAN. Mavenir supports splits 7.2 and 2 for its vRAN CU-DU-RU architecture so far, but will likely also be interested in the nFAPI interface based on 3GPP split option 6.

NODE-H

Node-H is currently working with partners developing 5G Enterprise cells for use in private networks based on the Qualcomm FSM100XX technology. The first cells will be available early in 2021.

Its 5G RAN software can run Intel or ARM hardware and interfaces to the SCF FAPI. It supports up to 100MHz bandwidth in sub-6 GHz and up to 400MHz bandwidth in mmWave. It can support up to 256 users depending on the power of the cell.

NOKIA

2020 marked a year in which Nokia progressively talked up its commitment to Open RAN, putting some blue water between itself and Ericsson and Huawei with support for open interfaces in the radio network. For small cells, this included a possible trail of an integrated distributed unit. The company also said that it would be working with Qualcomm as a chipset provider for its 5G small cells. Nokia said that it will develop 5G femtocells using Qualcomm’s FSM100xx chipset. Nokia calls its femtocell range Smart Node, and said the 5G version would be available in early 2021.

Nokia’s Smart Node femtocells - complete, discreet, very low power base stations that are often used in residential and SoHO or SME settings - are developed from its inheritance of an Alcatel-Lucent enterprise small cell product line that was also built upon a Qualcomm chipset. This announcement marks the move of this sort of product into 5G. The FSM100xx is a 5G capable small cell chipset that a number of developers are using to build 5G small cells. The company also markets its AirScale indoor Radio solution, ASiR, a solution that powers pico remote radioheads over Ethernet, connected to the Nokia Airscale baseband. In September, Nokia announced that Taiwanese mobile operator, Chunghwa Telecom (CHT) will be using 5G AirScale indoor Radio and the AirScale micro RRH for outdoor and urban hot spots.

SAMSUNG

Samsung’s most recent small cell is the Link Cell, a mmWave small cell built on Qualcomm’s 5G RAN platform. It integrates baseband, radio and antenna in one design - making it a discreet small cell that can backhaul over Cat 6 Ethernet. The first version of the cell will support 28GHz and has the capability to combine four 100MHz bandwidth. The small cells were picked up by Verizon, who said it would be trialling them in indoor locations.



SERCOMM

Bharti Airtel and Sercomm announced the launch of “the world’s first” vRAN-based TDD small cell. Jointly developed by Airtel and Sercomm, the small cell incorporates Split Option 2 technology. The manufacturer also announced that a new mmWave unit by the Qualcomm 5G RAN platform. Based on 28GHz mmWave 5G technology, Sercomm’s Enterprise mmWave Small Cell can reach gigabit level throughput with 4CC (Component Carrier) aggregation. Sercomm’s LTE CBRS Cat-A Indoor Enterprise Small Cell was OnG and FCC Part 96 certified in 2020. The SCE4255W is an LTE CBRS small cell. Sercomm partnered with AltioStar to add support for split option 2 on the SCE4255W.



# FREEDOM OF THE CITY

Picocom, the 5G Open RAN baseband semiconductor and software specialist, empowers wireless innovation by delivering technical and competitive advantage to its customers, enabling them to compete in the rapidly evolving disaggregated telecoms RAN market.

To find out how Picocom's class-leading technology and products for 5G small cell infrastructure can help you unleash your RAN contact: [info@picocom.com](mailto:info@picocom.com)



[picocom.com/freedomofthecity](https://picocom.com/freedomofthecity)