THE FUTURE OF CONNECTIVITY

A learning and networking event for the wireless connectivity industry and its customers

11-13 MAY 2021
VIRTUAL
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PUTTING THE C IN CONNECTED AND AUTONOMOUS VEHICLES

Launched in 2019 by motoring journalist Neil Kennett, CarsOfthefuture.co.uk is the home of news and views about driverless vehicles in the UK. Neil will be moderating the Automotive & Transportation session at the 2021 Small Cells World Summit.

Inspirited by the response to his 2018 long-read “Autonomous now: the shift to self-driving”, carsofthefuture.co.uk promotes UK-centric informed opinion on all aspects of self-driving – voices of reason in an area plagued by hyperbolic headlines and dominated by content from China and California.

Connected and autonomous vehicles (CAVs) divide opinion. Indeed, recent surveys have shown that people across the world are becoming more, not less, wary of them. For supporters, they represent a giant leap forward for mobility and road safety. For detractors, they are a nightmare mix of cybersecurity and ethical concerns. Our mission is to chart their development and encourage more sensible debate.

In the US, which is ahead of the UK in terms of on-road testing, a sentiment has not yet returned to what it was prior to these worries. Across the road are indications that overall, people are more, not less, wary of them. For supporters, they represent a giant leap forward for mobility and road safety. For detractors, they are a nightmare mix of cybersecurity and ethical concerns. Our mission is to chart their development and encourage more sensible debate.

This is perhaps not surprising when you consider headlines such as “Why humanity will come to regret inventing self-driving cars” or “Self-driving: the dream that drives the nightmare mix of cybersecurity and ethical concerns.”

Informed opinion on all aspects of self-driving – voices of reason in an area plagued by hyperbolic headlines and dominated by content from China and California. Neil Kennett, carsofthefuture.co.uk

“Some vehicle manufacturers are already using over-the-air (OTA) updates to fix problems before they occur and vehicle-to-vehicle alerts pre-empting crashes and saving lives. ABI Research estimates that carmakers’ revenues from in-vehicle payments will reach $4bn in 2026.

Go-anywhere driverless cars don’t yet exist, but they are coming. Will your kids’ kids drive? How do you tackle the problem of automated driving aids deskilling drivers? If you’re interested in these questions please sign up to our newsletter, follow us on social and get involved.

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**AGENDA IN FULL**

**DAY ONE TUESDAY 11 MAY**

**15:00 (1h 30 min)**
**State of the Industry Keynotes**
Role of versatile, low-cost mobile infrastructure
- Sue Monahan, Small Cell Forum: Introduction and SCF Small Cells Awards 2021: Shortlist
- Caroline Gabriel, Rethink Technology Research: Small cell market status – the numbers, drivers and barriers
- Julius Robson, Small Cell Forum: Small Cells 2021, Three tiers of diversification
- Peter Claydon, Picocom: Future history of small cells
- Gerardo Giaretta, Qualcomm Technologies, Inc.: Pervasive 5G coverage with Small Cells

**17:00 (1h 30 min)**
**Policy, Spectrum, Regulation**
- **Moderator:** Caroline Gabriel, Small Cell Forum Content Director
  - Prof. Simon Saunders, Ofcom: Open networks and vendor diversification in the UK
  - Monisha Ghosh, Federal Communications Commission: FCC Regulation for Small Cells
  - Chris Pearson, 5G Americas: 5G Progress in the Americas: Spectrum, policy and deployments
  - Gyan Koralage, edotco Group Sdn Bhd: Driving evolution of the towerco service model

**18:00 (1h 0min)**
**Breakout Session – Qualcomm Analyst Q&A**
- Gerardo Giaretta, Qualcomm Technologies, Inc.
- Roberto Kompany, Senior Analyst, Analysis Mason Small Cells and mmWave, Nokia

**19:00 (1h 0min)**
**Breakout Session – Picocom Analyst Q&A**
- Peter Claydon, Picocom
- Dean Bubley, Disruptive Analysis Ltd.

**20:45 (0h 15 min)**
**Day 1 Wrap-up**
- Prabhakar Chitrapu, Chair, Small Cell Forum

**DAY TWO WEDNESDAY 12 MAY**

**09:00 (1h 0min)**
**Breakout Session – Freshwave**
Exploring Multi-operator indoor coverage models for Europe

**10:00 (1h 0min)**
**Breakout Session – Colt**
Accelerating a post pandemic smart ‘X’ world

**11:00 (1h 40 min)**
**Neutral Host – In-Building**
- **Moderator:** Julius Robson, Small Cell Forum
- Dave Morris, JOTS and Telefonica O2: Joint Operators Technical Specification for Neutral Host In-Building (NHIB)
- Katie Pontin, Vodafone UK: Joint Operator Technical Specification for Neutral Host In-Building
- Graham Payne, Freshwave: Delivering in customer environments
- Stuart Holyoak, CommScope: Architectural Flexibility for Neutral Host Networks
- Victor Dot Piulachs, Cellnex Telecom: Neutral Host advanced connectivity, indoor & outdoor
- Stuart Bryden, BT Wholesale, Panelist

**13:00 (1h 15min)**
**Small Cell Products and Components**
- **Moderator:** Julius Robson, Small Cell Forum
- Vicky Messer, Picocom: The case for optimized silicon in 5G small cells
- Ganesh Shenbagaraman, RadiSys: Accelerating 5G Small Cell Adoption: The FAPI Approach to Open RAN
- Li Fung Chang, 5G Program Office, Industrial Technology Research Institute (ITRI): Open RAN: A Right Solution for Vertical?
- Prof. Rob Maunder, AccelerComm: Optimising 5G Small Cell Performance for Maximum Spectral Efficiency

**15:00 (1h 30min)**
**Commerical Property and Indoor Systems**
- **Moderator:** Mark Keenan, CEO, Real Wireless
- Chris Stratton, MLL Telecom Limited and Royal Institution of Chartered Surveyors: Telecom Deployments in the UK: The Telecom Code (Recent Developments) and what it means for Small Cells
- Darren Zitren, Cluttons LLP: Accelerating change for post-Covid commercial property
- Michael Ferris, Colt Technology Services: Multi-operator in building connectivity as a service
- Piercarlo Giannattasio, Cellnex Telecom: Options for indoor cellular SCF231
DAY TWO (CONTINUED) WEDNESDAY 12 MAY

15:00 (1h 30min)
Small Cell Open RAN

- Moderator: Julius Robson, Small Cell Forum
- Andrei Radulescu, Qualcomm Technologies, Inc.: SCF FAPI 3.0 and network FAPI 2.0
- Ganesh Shenbagaraman, Radsys, Rapporteur – SCF network FAPI
- Ravi Sinha, Reliance Jio, Open RAN with Open6: A business Disruption
- Dr. Balaji Raghothaman, Keysight Technologies – Test solutions for the Open RAN ecosystem
- Victor Torres, arQana Technologies – Harmonising reference designs for small cells

17:00 (1h 45min)
Industry 4.0 and Private Networks, Edge Computing

- Moderator: Phil Laidler, STL partners
- Alexandra Rehak, Cambridge Consultants – Case studies and customer insights for connected industries
- Abel Mayal, Airspan – Private Networks, pushing innovation through Open RAN
- Andreas Mueller, Robert Bosch GmbH and Chair of 5G ACIA – 5G for Connected Industries and Automation
- Yongbin Wei, Qualcomm Technologies, Inc – Driving the Industrial Revolution with 5G Connectivity
- Daniele Munaretto, Athonet/5G CONNI – Private 5G for Connected Industries

17:00 (1h 30min)
Open RAN Ecosystem

- Caroline Gabriel, Small Cell Forum, Content Director
- Richard Mackenzie, Telecom Infra Project (TIP)/BT: Practical implementation considerations of Disaggregated RAN
- Anthony Magee, ADVA: Mobile transport unchained
- Matteo Fiorani, Ericsson: Panelist
- Adrian O’Connor, Benetel Ltd.: Panelist

18:00
Breakout Session – Ericsson 1h 00min
Ericsson Indoor World Tour

- Dr Jessey Huang, Head of Product Management Indoor Radio

19:00 (2h 30min)
Emerging Technologies
Developing small cells, emerging tech

- Prabhakar Chitrapu, Small Cell Forum: 5G-SC & Wi-Fi6 Convergence: SCF & WBA Perspectives
- Bruno Tomas, Wireless Broadband Alliance (WBA): WBA Perspective on 5G & Wi-Fi6 Convergence
- Ravi Sinha, Reliance Jio: Edge & Cloud Computing for Small Cells
- Ravi Puvvala, Harman: Smart Cities including Cellular-V2X
- Robert Gazda, InterDigital: Visions of 6G & Small Cells
- Sanjeet Pandit, Qualcomm Technologies, Inc., Panelist
- Azad Singh, Reliance Jio, Panelist

20:00 (1h 0min)
Breakout Session – Keysight

- Keysight Test Solutions for Small-Cell Providers

21:30 (0h 15min)
Conference Wrap-up

- Prabhakar Chitrapu, Chair, Small Cell Forum

DAY THREE THURSDAY 13 MAY

09:00 (1h 0min)
Breakout Session – Airspan
Accelerating Innovation with 5G Open RAN

13:00 (1h 0min)
Breakout Session – Dense Air
Targeted Small Cell Deployment using Big Data insights

14:00 (1h 0min)
Breakout Session – CommScope
Timing the 5G Wave: Market Drivers, Trends, Opportunities & Challenges

15:00 (2h 0min)
SCF SMALL CELL AWARDS 2021

- Judges’ Open RAN panel session
- Sue Rudd, Strategy Analytics Inc
- Simon Fletcher, Real Wireless
- Keith Dyer, The Mobile Network
- Caroline Gabriel, Rethink Technology Research
- Awards ceremony

Information correct at the time of going to press
WELCOME TO SMALL CELLS WORLD SUMMIT 2021

Every year SCWS provides an excellent opportunity for our industry to come together, to network, to share knowledge and to debate the big topics in our industry. This year it feels more important than ever, not least because of the exceptional year we have all had with the global pandemic and it has been two years since we met at the last SCWS in 2019.

We hope to bring SCWS back to London in 2022, so we can meet and celebrate together in person, but this virtual event is an exciting opportunity for us to gather a wide global audience. Small Cell Forum runs and organizes SCWS not as a profit-making exercise, but because we know it matters to our members and the wider eco-system. Feedback from the industry has been fantastic, and we are grateful to our fantastic sponsors for supporting this event again this year.

Ownership of this event has meant we can use our knowledge and understanding of the industry to set a thought-provoking and unique agenda that benefits all involved. New this year are our ‘sector spotlight’ sessions, which tackle specific use cases – automotive, commercial property and Industry 4.0 – that are increasingly bigger parts of the business case for small cells and 5G. These sessions include representatives from the respective industries to discuss their connectivity needs and requirements, alongside vendors and deployers who have case studies of connectivity in action.

We also have a selection of ‘breakout’ sessions from our sponsors, everything from workshops, to Q&As and online demos. These are more intimate sessions of 50 delegates maximum, so I hope you get the chance to join some of these.

I would also urge you make the most of the networking capabilities within the event platform, to connect with other delegates and set up meetings, or use the chat and message bars to leave feedback and comments.

As with previous years, in this program, you will find the exclusive release of our latest Small Cells Market Status, with new forecasts and data. There is also interesting editorial from our sponsors and partners.

Lastly, don’t forget we will be celebrating the very best of our industry at the SCF Small Cell Awards on 13 May at the end of the conference – we are all excited to find out who the winners will be this year.

On behalf of Small Cell Forum, I hope you have a fantastic event.

SUE MONAHAN, CEO
SMALL CELL FORUM

Join Gerardo Giaretta, Senior Director, Product Management @ Qualcomm Technologies, Inc. as he presents “Pervasive 5G coverage with small cells” during his state of the industry keynote on Tuesday, May 11th.
INTRODUCTION:
DIVERSIFICATION IS THE KEY THEME OF SCF’s 2021 SURVEY

A key role for Small Cell Forum (SCF) is to maximize scale and diversity within the ecosystem, while providing unified foundations that avoid fragmentation.

This has always been SCF’s goal but, in the past few years, it has become more critical and more challenging than ever before. The presentations and discussion on this year’s Small Cells World Summit program, as well as SCF’s growing membership list, reflect this growing emphasis on new business models, new players and, in some cases, new roles for veteran players. This is also reflected in the results of SCF’s 2021 operator survey, which is the key input to our upcoming annual Market Status Report and forecast.

In total, 84 mobile network operators (MNOs) and 33 other small cell deployers, including private network operators and neutral hosts, responded to this year’s survey, which was conducted in the first quarter of 2021. As part of the event program, we are publishing highlights of the forecast that is built on the operators’ inputs and other metrics. The responses amplify important themes that are reflected in the conference program and in SCF’s work agenda for 2021.

The dominant preoccupations cited by the service providers relate to the diversification of the value chain (operators and suppliers), of the small cell network architecture, and of the use cases and deployment environments. These themes stimulate innovation and a broadening ecosystem, which is reflected in SCF’s burgeoning membership among groups, such as neutral hosts, that would not have been prominent five years ago.

The small cell industry is becoming extremely diverse. In the 5G era, platforms need to deliver a wide variety of services and use cases, especially as small cells will support the majority of cellular expansion into enterprise, industrial and mission-critical environments. Networks will need to be flexible and programmable, in order to be adapted cost-effectively for services that may require very low latency or very high device density.

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FSP 150-XG118Pro cell site gateway with VNF hosting
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The expansion into supporting business-critical applications for many industries will introduce a new diversity of players and service providers, which can bring specialized industry knowledge and a variety of business models to suit different enterprise scenarios. We see mobile operators establishing dedicated enterprise or private network operations; the rise of specialized private network operators; neutral hosts that can support multiple service providers in many environments; and equipment vendors or hyperscalers adding small cell deployments to their portfolios.

The increasing variety of use cases and deployment environments demand a wide range of different small cell form factors and architectures to make them deployable and flexible. As the density and latency of networks become more challenging, there will be a growing number of moving parts. Many small cell networks will be disaggregated, with separate radio units and one or more baseband units; in many cases, these will be integrated with edge computing nodes that can support the basebands as well as enterprise services; there will be more spectrum bands, antennas and of course devices, in play than ever before.

This density and diversity will place a heavy focus on automation of the operations, optimization and management of the small cells. In our operator survey, we emerged that ease of deployment and management, including automation, are regarded among the most important factors that will accelerate or slow small cell rollout, depending how effectively it is enabled.

While diversification drives innovation and new revenue streams, it also comes with the risk of fragmentation. This is where SCF’s role is particularly crucial. We distill a wide range of operator and service provider requirements into a common framework. And we devise specifications for common interfaces from chip level to fronthaul to APIs, which add up to a common foundation that can drive huge scale, and the economies that go with it, while also allowing many players to innovate on top of the platform.

Uncertainty about the economic effects of the crisis, and about supply chain disruption, have introduced some delays and caution into the deployment picture for 2020 and 2021, but operators are clear that these slowdowns are temporary, and the fundamentals of their deployment models are largely unaffected over the medium term.

Our forecast suggests slightly slower deployment than we anticipated a year ago, in the 2020-2021 period. Stay-at-home policies associated with the pandemic have increased the need for robust mobile infrastructure and will drive redoubled investment from later this year. However, in 2020 and 2021 this was offset, in the outdoor environment, by disruption to labour and site access because of lock downs, and in the enterprise, by delays to workplace upgrades as a result of work-from-home policies.

As Figure 1, shows, there will be strong recovery from 2022, driven in particular by 5G upgrades in all environments (see Figure 2). By 2026, we expect the industry to have deployed 35.7 million radio units cumulatively, which is about 10% more than forecast in our previous report, although with greater weighting towards mid-decade.

The compound annual growth rate (CAGR) between 2019 and 2026 will be 13% in our moderate scenario. The highest CAGR will be in urban outdoor small cells, driven by major densification and smart city projects in large Asian markets, the US and parts of Europe and Latin America. However, that will come from a relatively small base and enterprise small cells will remain the largest percentage of unit deployments, accounting for 62% of rollouts in 2026 and 70% of the total across the period of the report.

Across all scenarios, the rising pace of deployments and upgrades to support 5G (alone or alongside 4G) will be the key driver of accelerated small cell rollout after 2022. In the enterprise market, 4G is currently still the workhorse, underpinning a sharp uptick in deployments in 2019-2021, but from early 2023 we expect a combination of factors to drive a new wave of enterprise investment based on 5G. This will be less about upgrades to 4G networks, and more about new build outs to support enterprise use cases that are very 5G-reliant, such as ultra-low latency mobile robotics; or extensions to WiFi or wireline networks to add 5G functionality such as high-speed hand-off.

Outdoors, the emphasis in the first wave of 5G has been on adding capacity and coverage to macrocells in midband spectrum, and most densification has been in 4G, with the notable exceptions of China and Japan. From 2023, we expect to see the start of growth in 5G deployments for ultra-dense environments such as transport hubs and to support mission-critical smart city applications such as intelligent transport systems. There will be heavy correlation to investment in edge cloud infrastructure by operators, either directly or via public cloud partnerships.
Figure 2 shows that the transition from 5G NR non-standalone (NSA) architectures to 5G standalone, which requires a 5G core, is the biggest trigger for 5G densification as this core will be needed for the advanced applications. In 2019-2022, in most scenarios, 4G will deliver similar performance to 5G NSA for a lower cost, though coexistence between 4G and 5G, with a common core, will persist throughout the decade. The rollout of new 5G or 4G/5G units will overtake that of 4G only in late 2023 but by 2026, over 90% of new deployments will be 5G or 4G/5G.

Regionally, Asia will remain the biggest driver of small cell deployment throughout the period (Figure 3). The first phase of densification was led by Japan and South Korea, but rising activity by China and also by the US from 2018 was responsible for much of the scale achieved by 2021. These countries remain the biggest single deployers, especially outdoors, though their share of total build-out will decline from 2023 as their networks become fully densified and as other countries, such as India and Italy, become bigger builders. European operators will proceed at a slower pace than other developed 4G/5G regions until at least 2023, particularly outdoors, where regulatory barriers have been significant. Lowering of those barriers outdoors, and significant enterprise 5G deployments indoors, in countries such as Germany, Sweden and Italy, will help to drive adoption in Europe in the later part of the forecast period.

One of the most important enablers of densification in the 2020s is availability of larger quantities of affordable spectrum. This is coming from two main sources. One is the development of 5G radios that operate more efficiently in higher frequency spectrum than was practical for previous generations – notably the midband 5G spectrum in 3.4-3.8 GHz, and the millimeter wave bands such as 26/28 GHz and 39/41 GHz. Higher frequencies are well-suited to small cells because they support very high capacity but very short signal range, while developments in beamforming and antenna technology is helping to address propagation challenges indoors or in dense built-up areas.

As Figure 4 (p18) shows, mmWave is a relatively small part of the picture until 2023 (except in markets, such as the US, where it is used for fixed wireless access, but these systems are not included in the small cell forecast). But from 2026, the largest number of new or upgraded small cells will be deployed in spectrum above 10 GHz (though, of course, this partly reflects the fact that more cells are required, in high bands, to cover the same area).
In many markets, some of the mmWave spectrum is being earmarked for shared usage, or for short-term or localized licences that are designed to stimulate enterprise adoption of 5G. That, in turn, helps to diversify the base of service providers and enable enterprise networks to be built, even if the business case is not attractive for the primary licensed spectrum owners. Even in conventional auctions, mmWave licences are tending to be low cost on a per-MHz/POP basis, because the capacity of these bands does not encourage a land-grab.

The other important source of new spectrum is shared or unlicensed airwaves for cellular networks. Although implementations of LTE for the unlicensed 5 GHz band have not gained much traction, there are higher expectations for 5G-unlicensed, which was recently standardized and may target the newly extended licence-exempt spectrum around 6 GHz. However, given WiFi’s incumbency in 5 GHz and 6 GHz, the more interesting spectrum developments revolve around dynamic or shared spectrum schemes, which allow light licensing, or for different service providers to use the same spectrum on an on-demand basis. To avoid the congestion and interference that can affect overcrowded unlicensed bands, these schemes use a spectrum access system (SAS) to enforce priorities of access. CBRS is the most prominent example.

Figure 5 shows the rapidly growing impact that shared spectrum will have on small cell deployment, especially as many of these flexible schemes are in higher frequency bands such as those around 3.5 GHz (CBRS) or in mmWave. From 2015, we expect more new small cells to be deployed or upgraded in shared and unlicensed bands than in licensed spectrum. That also reflects the rising significance of non-MNO deployers, who are the most inclined to use shared spectrum, and for that reason, shared spectrum small cells will be most common in enterprise environments, where the non-MNOs are more dominant than outdoors. However, some MNOs will also use shared spectrum to ease pressure on their expensive licensed bands (which some will keep for premium users or applications), or to improve the business case for an enterprise deployment.

Creative shared spectrum schemes constitute one major trend that is expected to revolutionize small cell network TCO – and therefore enable a broader supplier and service provider ecosystem. The other is the emergence of open RAN architectures. These establish open interfaces at each layer of the network, from the chipset (such as SCF’s FAPI and 5G FAPI), to the xHaul between different network elements in a vRAN (such as SCF’s nFAPI or O-RAN), to the APIs for processes such as network automation.

Figure 4. New deployments and upgrades of small cells by spectrum 2019-2026 (primary band)

Figure 5. New deployments and upgrades of small cells by licensed or shared/unlicensed spectrum (primary band) 2019-2026
Truly open interfaces, agreed by broad forums and geared to operator requirements, can enable multivendor networks in which deployers can mix and match the hardware and software elements that best suit their requirements and budget, while remaining within uniform silicon and architecture frameworks that ensure interoperability and scale. These open architectures are likely to be adopted at scale first in small cell networks, especially enterprises and smart cities, because these will be largely greenfield rollouts, often by non-traditional operators. That means the impact of the open network can be maximized because there is no legacy to manage, as there is in a macro network, and the operator does not face the cost and risk of transitioning an installed macro RAN to a brand new architecture.

Figure 6 shows that in 2024, more than half of new small cell deployments or upgrades will be based on open vRAN interfaces, and this figure will rise to 74% in 2026. The adoption of open architectures will often go hand-in-hand with virtualization of the network, especially where operators choose a two-split architecture that has the baseband functions divided between a distributed unit and a centralized unit (see Figure 17, p31).

Figure 7 shows the progress towards adoption of the new disaggregated and virtualized RAN architectures in the small cell environment. Some operators have already deployed small cells that disaggregate the radio unit from the shared baseband, usually in an enterprise environment where some vendors have offered such architectures for some years. Early products did not support NFV-based virtualization of the baseband functions but almost 10% of operators have deployed at least some small cell vRANs, which do implement virtual network functions (VNFs), often on general purpose cloud hardware.

Both these architectures will see significant growth in 2021-2023, while by the end of that period, over one-quarter of operators expect to be moving from VNFs towards the more advanced cloud-native network functions (CNFs), which implement the RAN software in containerized, Lego-style microservices on cloud infrastructure. There is considerable certainty in operators’ minds about their timescales to move to vRAN and cloud-native RAN, and this is generally a shorter timeframe than to make the same migration in their main macro networks. One-third or fewer of the respondents had no idea when they might start deploying the new architectures.

A fourth significant change is to deploy the baseband functions in the public cloud, sometimes in conjunction with managed services to operate the radios. This is more speculative for many operators and almost half have no certainty about whether, or when, they might use this approach in certain scenarios.

The full story originally appeared on a LinkedIn post published by Stuart Holyoak.
FREEDOM OF THE CITY

The silicon at the heart of Open RAN small cells
Small Cells with Big Results

Last year we launched Freshwave, with the mission to make digital infrastructure simple. With expertise in multi-operator in-building coverage, outdoor small cells, mobile private networks, and masts, bringing connectivity to wherever people live, work and play is at the heart of what we do. And since then, Covid has only highlighted how important connectivity is to businesses and communities.

I’ve been really inspired by the resilience and dedication of the telecoms industry during the pandemic. Particularly the sustained commitment to innovation despite very challenging delivery circumstances. As ever, Freshwave have been at the vanguard for new ways of deploying small cells, whether through delivering multi-operator connectivity to businesses, innovative solutions for mobile private networks, or new models for local authorities.

In 2019 in a first for the UK, Vodafone agreed to share some of its spectrum with us to help offer high-speed mobile broadband in remote areas without fibre connectivity, as well as to promote efficient use of its spectrum. Using this spectrum and small cell technology, we developed the idea of deploying a mobile private network at a leading holiday park site, which has now been operational since August 2020. Outdoor small cell technology brings 4G data speeds to each lodge in the park via a small antenna on each lodge. An “off the shelf”, standard 4G router then distributes the signal on each lodge. An “off the shelf”, standard operational since August 2020. Outdoor leading holiday park site, which has now been deploying a mobile private network at a

Meanwhile, momentum around delivering shared digital infrastructure outdoors is also increasing. In 2018, the Cabinet Office and the Department for Digital, Cultural, Media & Sport first published its Digital Infrastructure Toolkit. It contains guidance for industry and government departments on agreements to use central government sites for digital communications infrastructure. It was also created as a best practice example for local authorities and other arm’s length bodies in how to enable the efficient rollout of the digital infrastructure that is critical for the digital economy.

Working with Croydon Council, we were the first network service provider to sign an open access agreement with a council. From signing the agreement to deploying the 4G small cells on shareable council-owned assets (lamp posts) took just two weeks. This was in June 2020, in the midst of the pandemic when connectivity had never been so important, and illustrates how open access can speed up the deployment process.

The non-exclusive approach makes it quicker and easier to enhance mobile coverage, benefitting residents and local businesses and improving digital inclusion. It also benefits the mobile operators by enhancing connectivity for their customers. And all the infrastructure also has an upgrade path to 5G, which will help speed the adoption of this technology in the future. In the council’s announcement of the open access agreement, Matt Warman MP, Minister for Digital Infrastructure, said: “This landmark agreement breaks through one of the biggest barriers to delivering better mobile coverage to people, no matter which network they use.

“Open access telecoms infrastructure is not only the quickest and cheapest way of providing seamless 4G coverage, but it will also pave the way to delivering the economic and social benefits of next-generation 5G technology for our communities. I hope other councils now follow this forward-thinking move by Croydon.”

We believe this is just the beginning and I’m excited to see this model deliver connectivity and commercial benefits for residents, visitors and businesses across the UK.

Graham Payne
Executive Chairman, Freshwave
Whether the enterprise and indoor segments will end up closer to the best case or the worst case will not be only determined by response to the tumultuous events of 2020 and the years of coal. Each year, SCF asks the operator survey panel which factors will be most important in either accelerating their deployments, beyond what they are currently anticipating, or holding them back. In this year’s survey, the top factor emerged as the degree to which network operators could be automated to improve cost, scalability and simplicity. This was cited as a top three concern by 45% of operators, followed closely by the related factor of TCO. Other important issues that could speed up or slow down rollouts in this environment include:

- the availability of technologies that can support specific and demanding enterprise use cases such as ultra-low latency, as those are often the drivers for investment in cellular/5G as opposed to WiFi
- the clarity of the ROI case, which often relates to the above, since these specialized capabilities may be key to the revenue opportunity for the service provider
- Simplicity of deployment – as in the operations and management factor, enterprise deployers are looking for streamlined, simplified and automated processes. This contrasts with the urban or macro environments, where extremely high traffic and QoS demands place more emphasis on optimization even at the expense of cost and time to deploy
- Revenue and risk sharing structures between operators, enterprises and potentially other stakeholders – there have been a number of enterprise cellular in many scenarios, since most companies have been less willing to fund small cells themselves than they have been for WiFi or LAN.

Even in 2026, 22% of new deployments or upgrades will be of integrated small cells and 26% will be DAS, while the disaggregated networks will be split between 26% of radio units in two-unit systems and 32% in three-unit.

The lack of a one-size fits all platform is unsurprising when we consider how many different industries are interested in having cellular networks that not only improve coverage and capacity for their buildings and campuses, but can be fully optimized for their particularly processes and services, and controlled in the same way as their other corporate networks.

Figure 11 shows the breakdown in deployments between the dominant business models in the enterprise indoor market. These models are:

- In-building services delivered wholly on the public MNO network, in an outside-in way. This was, before the advent of small cells, the only way to enable enterprise cellular but in-building penetration was frequently poor, and remains challenging, especially in spectrum above 2 GHz. That has resulted in limited use of cellular networks by companies indoors and a reliance on WiFi.
- Neutral host networks, deployed in enterprise environments for public use, and to support multiple operators or service providers. Examples include multi-operator networks within retail malls or stadiums.
- Private networks, which can be deployed and managed by a wide range of organizations, including MNOs or neutral hosts (see Figure 14). These are under the control of the enterprise and access is only for the enterprise itself and its authorized partners, customers and guests. We divide private networks into three main types – those deployed and run by the enterprise itself, deployed by a third party service provider but run by the enterprise; deployed and run by a third party service provider.

Figure 15 shows the declining role of the public MNO network in enterprise indoor environments, for the reasons stated above. It also shows the reluctance by most enterprises to deploy and run their own networks, since few have skills in cellular platforms. Indeed, even managing networks that a third party has built will be a declining option as more service providers offer managed services similar to those available in enterprise WiFi. By the mid-2020s, the fastest growing model will be public-facing neutral host, as large locations such as stadiums and transport hubs require high quality and ultra-dense 5G, and the largest category will be the fully outsourced private network, accounting for 34% of radio units deployed in 2026.

Within the three private networks categories, there will be many organizations seeking to build a business and this will be the area of the small cell industry that most drives diversification in the deployment chain. As Figure 15 shows, pure-play private network operators will be the biggest category of deployer by 2026, overtaking the vertical market specialist integrators that have dominated the traditional proprietary private networks space.

Other groups will include neutral hosts that, rather than focusing on public-facing networks, build networks for private enterprise use that can support multiple operators. These are likely to be strong in large organizations or campuses where users have contracts with many MNOs, or where the enterprise wants to support a wide variety of services, enabled by different service providers, on a single cellular network.

Some MNOs and telcos are setting up separate private network divisions and are heavily investing in the vertical market specialist integrators that have dominated the traditional proprietary private networks space.

But all those architectures retain an important role, depending on the particular use cases and traffic patterns the network must support, and the shape and size of the buildings.
REGULATORY BARRIERS REMAIN FOR OUTDOOR CELLS, BUT NEW DEPLOYMENT MODELS WILL HELP TO LOWER THEM

Enterprise and indoor small cells are the engine behind densification in the 2020s because so many 5G-era use cases are primarily focused on indoor or outdoor/indoor usage, and the clearest new commercial opportunities in cellular come from the enterprise segment.

However, the relentless rise of consumer mobile broadband traffic will continue to drive usage in all environments and it will increasingly be accompanied by greater quality of service demands – that gaps in coverage or spots of inadequate capacity will not be forgiven by someone playing high end games or engaging with virtual reality smart city services.

The barriers to outdoor densification are very different to those indoors. In the enterprise, simplicity, cost-effectiveness and integration with existing infrastructure and cost models are key. Outdoors, many of the factors that could hold back deployment still relate to physical infrastructure such as sites and fiber, and the cost and bureaucracy of rolling out large numbers of cells in urban environments.

According to our operator survey, access to affordable site, as well as broader TCO and ROI considerations, will be the most important factors that will either accelerate or slow down deployment compared to current plans – and so decide how close the industry comes to the best- and worst-cases outlined in Figure 16.

SCF has been active for several years in influencing policy makers around the world to simplify and streamline regulations affecting access to sites, and permissions to deploy equipment (a standardized approvals process is also in the top 10 requirements to accelerate build-out by 2026). This is especially urgent in Europe where, through the work of SCF, GSMA and others, significant progress has been made to create a workable regulatory framework, especially for municipal sites, but wider implementation is needed to allow the region to catch up with other developed mobile economies in terms of outdoor densification.

Figure 16. Key factors that will accelerate or hold back deployment of urban small cells before 2023
Connectivity’s role in Smart X

“Smart X” applications are data-centric, have cognitive function embedded and provide real time and dynamic response capabilities.

As verticals go through a transformation programme to become “smart X” they are leveraging the IoT to make business and operational activities data-centric. This relies on AI to deliver actionable insights, as well as on the agile, dynamic and adaptive connectivity to deliver on dynamic SLAs and inter-connect the digital ecosystem required.

As part of their transformation journey, enterprises will embark on a cloud migration journey as they expect services from cloud providers to cover the ground for them. Armed with backhaul that includes 5G technologies, operators can co-enable a new generation of services from cloud providers that leverage the edge and the distributed cloud stack to enable smart services to enterprises.

Most of these ‘smart X2’ applications will also be edge enabled, relying on distributed topology and architecture of the whole stack: application, platform security and of course connectivity. The edge needs fast, reliable connectivity and 5G meets that requirement while cloud services often demonstrate the overlap between the edge and 5G, particularly from an enterprise perspective as they procure services through cloud providers taking the same route to expand their edge and IoT capabilities.

The best results from 5G ecosystems emerge from collaboration between stakeholders such as cloud providers, and communication service providers, as well as technology and GTM partners. This is why market incubation has become an essential stage of the innovation workflow:

It enables realisation of the value chain created by the edge while helping the ecosystem to validate their business positioning within the entire solution stack.

In smart verticals, we want to leverage 5G and IoT and create synergies with Colt’s intelligent and edge centric connectivity to become an enabler of innovation and transformation.

We believe we are well-positioned to support our customers through these transformation programmes as we are ahead in the journey of becoming a digital service provider ourselves.

I’m part of the Strategy and Transformation team at Colt, we are responsible for defining long term strategy and pioneering emerging technologies through key workflow activities; innovation strategy where we identify opportunities and ideate within it, and innovation development where we take ideas from concept to launch through a collaborative approach with a broader innovation ecosystem. Co-innovating and developing with partners and customers for us is a must.

Small cells are a key part of the connectivity puzzle for delivering a smart vision, along with an ultra-low latency, intelligent network. We’re always looking for new partners to join our innovation ecosystem. It’s through these partnerships that we’ll be able to truly deliver on a smart vision of the future.

Another important area of concern, as in the indoor environment, is to ensure the new small cell networks do not only plug coverage gaps or boost coverage in a targeted way. Additionally, ROI can be improved, and the service delivery case broadened, if the networks are planned with advanced use cases in mind. Support for capabilities such as low latency will extend the type of services an operator can offer and support government or enterprise objectives such as support for critical infrastructure.

Enabling advanced 5G capabilities, even if these are not activated in the first year, and integration with edge computing, are both factors that will drive deployment by increasing the value of the network to all stakeholders and future-proofing it for emerging applications.

In architecture terms (Figure 17) there is a contrast between the patterns of adoption for outdoor compared to indoor small cells, with a more rapid migration after 2022 to disaggregated networks that have a separate distributed unit (DU) to support Layer 1 and 2 network functions that need rapid response and, therefore, a cloud node close to, or on, the cell site. This will be an important architecture for dense city networks that will have to process very large amounts of traffic, often spanning multiple spectrum bands and RATs, with high QoS – all of which places a significant processing load on the system. Meanwhile, running non-real time functions on a centralised unit can improve coverage and QoE by allowing resources to be allocated flexibly across a city, and provide economies of scale.

Integrated small cells will still play a major role in the outdoor environment, especially to fill gaps in macro coverage tactically or serve a very localized area. They will still represent over one-quarter of new units deployed or upgraded in 2026, and one-third of the total deployed over the whole period of the study. There will also be a limited but interesting rise in deployment of digital DAS networks in outdoor environments, especially in the US and China.

The diversification of the service provider base is less dramatic in the outdoor and public-facing environment than in enterprise networks because this will remain the core business case for the MNO, and the majority of urban and rural build-outs will be to improve coverage, capacity and QoE for a licensed operator’s macro network, and to enable them to support more 5G use cases.

Figure 17. New deployments and upgrades of outdoor small cells by architecture 2019-2026.
The increasing diversity of the services small cell networks must support, the environments they are deployed in, and the organizations that build and manage them, will help to accelerate deployment in the early 2020s. It also has a profound impact on the whole supply chain, as the requirements for design and performance of small cells also become very diversified to support different business cases. This is highlighted by a survey of two sets of operators, in which we asked them to rank 12 design capabilities. The chart shows the overall prioritization, and the contrast between the requirements from different deployer groups (Figure 19).

MNOs emphasise performance and classical network features such as capacity and power, and the small cells are part of a broader architecture. This is especially true outdoors.

Non-MNOs are mainly targeting indoor and enterprise and are interested in ease of deployment and management and integration with other enterprise systems such as LANs and edge. Vendors need to support a wide variety of form factors for different use cases and verticals – that means they need frameworks in which many different units can be easily integrated and automated, and a flexible approach to form factor, so that units can be tailored easily for a particular area of demand.

This point is worth emphasizing because it will lead to many opportunities for vendors and component makers to innovate and differentiate, and to develop solutions that are not vanilla, but are optimized for particular scenarios. But this makes the role of SCF more important than ever, both to capture the requirements that the supply chain must address, but also to provide the unified framework in which diversification can thrive but not lead to fragmentation. Success in this goal will greatly accelerate the deployment of small cell networks by a wide range of service providers over the coming five years.


**THE POWER AMPLIFIER AS A KEY COMPONENT FOR ENABLING 5G SMALL CELLS**

New generation of Power Amplifiers is helping to address the challenges facing small cells

**Infrastructure 2.0**

The wireless industry is moving from today’s network towards the next generation of 5G network infrastructure, promising higher data rates and reduced latency. Consequently, mobile network operators focus on three key requirements: performance, size, and value.

**Small Cells**

Compared to previous generations of wireless communications, 5G is developing solutions at higher frequencies of operation in order to increase the data throughput. However, this also means that the distance at which signals can travel is shorter. Therefore, 5G radio units need to be much smaller, closer to each other and denser than ever. This opens a vast new opportunity for small cells because more radio units are needed for 5G, having more stringent size, cost and performance requirements so that they can be easily integrated into dense urban environments.

**The Power Amplifier**

Power Amplifiers (PAs) are used to enhance signal strength and improve the quality of the communication link, thereby enhancing data transmission. They are one of the largest contributors to power consumption and they impact directly how much heat is generated by the small cell.

**Amplifier Key Parameters**

Selecting the correct PA in terms of technology and performance is a critical task since it directly impacts the small cell overall performance, cost, and quality. Here are some key parameters to look for when selecting a PA for a small cell:

- **High Efficiency:** The PA is one of the most power-hungry devices in the transmitter path of a small cell. A power amplifier with a low efficiency results in more dissipated power for the same average output power compared to a high efficiency PA. This directly affects the thermal management by requiring additional cooling elements, which increase the size and the price of the small cell.
- **Linearity:** Linearity expresses how well a PA can amplify a signal without distorting its content. The PA linearity has a direct impact on system range capacity and the maximum achievable data rate, especially important for 5G communication systems.
- **Pin-to-Pin Compatibility:** A power amplifier is power and frequency selective and hence supporting multiple frequencies or even power levels might require different power amplifiers. Selecting a PA from a pin-to-pin compatible PA family, has the advantage that it reduces complexity, it gives flexibility to system integrator and hence reduces small cell cost.

**Multi-Chip Modules (MCM)**

Power amplifier MCMs are typically fully impedance matched, they offer a very high level of functional integration, ease of use, cost reduction and they deliver the right performance necessary for driving the small cells market.

**Conclusion**

With forthcoming 5G small cells, infrastructure companies will increasingly require network-scalable, compact and high-performance RF component solutions to meet carrier bandwidth demands and power-efficient MCM PAs are playing a crucial role in helping these companies manage the high requirements.

**Reference Designs**

AtQana Technologies is working on a reference design for small cell applications. Their multi-chip module [MCM] reference design, has the advantage that it integrates multiple functionalities in a single module, thereby reducing the size and complexity of the small cell.

**Victor Torres**

VP of Marketing at AtQana Technologies

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**SCF Small Cell Awards 2021**

For over a decade the SCF Small Cell Awards has been recognizing the very best deployments, innovations, and new use cases for small cells in our industry. And after a year in which the world has been faced with a pandemic, we have even more cause to celebrate and congratulate those businesses that have excelled over the past 12 months.

Independently judged by leading analysts and journalists and organized by Small Cell Forum, the SCF Small Cell Awards are upheld as the Oscars of the small cell industry.

The awards recognize both technical innovation and commercial success, and the integrity and objectivity of the judging process means they are a genuine help for operators making buying decisions. They are open to the whole industry (not just SCF members) and will be celebrated at the virtual ceremony at the end of Small Cells World Summit 2021.

**Award categories**

Our industry is changing rapidly. Small cells used to be all about indoor coverage, but today small cells are finding vital roles in every aspect of network design, not least to provide capacity for incoming 5G. They will be the enablers of IoT innovations and 5G businesses cases globally, and they are bringing connectivity to rural and remote scenarios. To reflect the changing nature of, and technology within, the industry, this year’s award categories now include topics such as 5G migration, SON and Orchestration, and RAN.

1. Excellence in commercial deployment by an MNO
2. Excellence in commercial deployment by an alternative service provider – e.g., private network operator, neutral host
3. Commercial Small Cell (Network) Products & Technology
4. Software and Services – Management, Orchestration and Automation
5. Innovation in emerging technology or architecture
6. Outstanding innovation in chips or components to enable small cell network
7. Outstanding Innovation in Small Cell Business Case
8. Commercial product or service to enable multi-operator and neutral host business models
9. Outstanding Contribution to Small Cell Open RAN platforms or standards
10. Social Impact – Promoting Small Cells for Social/Economic/Environmental Development
11. Special Category – Judges’ Choice
Meet the Judges

Caroline Gabriel (Chair of judges)
Research Director, Retriwk Technology Research

Caroline co-founded Rethink Technology Research in 2002 to focus on emerging mobile technologies and their impact on operator business models. She has been analyzing and reporting in the hi-tech industries since 1986 and has a huge wealth of experience of technology trends and how they impact on business models. She started her career as a technology journalist and then took senior roles in online publishing and research before focusing full time on wireless industry research and consultancy.

Keith Dyer
Editor of The Mobile Network

Keith Dyer is editor of The Mobile Network, a title that tracks the development of mobile network technology and mobile operators’ network investment strategies. Keith has tracked the development of small cells since the foundation of the SCF, both in terms of vendor R&D and operators’ deployment strategies. He has enjoyed being a judge of the Awards on several previous occasions.

Simon Fletcher
Chief Technology Officer, Real Wireless

Simon is Chief Technology Officer for Real Wireless, the world’s leading independent wireless advisory firm. With over 20 years working in the design and development of technical telecoms infrastructure, Simon’s recent focus has been on future cities, the application of 5G and IoT in industry verticals with an event horizon towards 2030. His long participation in Common Public Radio Interface (CPRI) defining early C-RAN concepts brings great foresight on an important architectural element of emerging 5G architectures. Simon is also currently acting as chairman of the Cambridge Wireless, Future of Wireless Conference Organising Committee and Small Cell SIG Champion.

Sue Rudd
Director, Service Provider Analysis, Networks and Service Platforms, Strategy Analytics Inc.

Sue has over 30 years’ experience with Communications Service Providers (CSPs) developing business cases for mobile broadband, voice and value-added IP services. At Strategy Analytics, Sue focuses on matching new technology to business opportunities for SON, HetNets, eRAN/Cloud RAN, small cells, Wi-Fi, Edge services and video delivery optimization as well as SDN/NFV and telco cloud service opportunities that demand virtualization, network slicing for QoS, traffic optimization, global roaming, secure signaling etc. Her reports cover competitive analyses of service platforms, OSS and database requirements and business cases to maximize CSP Revenue per GB.

Ceremony

This year’s SCF Small Cell Awards ceremony will, of course, take place virtually, at the end of Small Cells World Summit 2021, on 13 May. The shortlist will be announced at the beginning of SCWS on 11 May and any shortlisted videos submitted by entrants will be hosted on the conference platform.

We are delighted to be hosting a short analyst session at the beginning of the ceremony, where our fabulous judges will discuss industry trends and topics from the conference.

Honoring diversity

Caroline Gabriel Chair of judges

I’m honored to chair the judging panel once again of SCF’s annual awards. At the current time, it is more important than ever to recognize achievements that will help our industry, and all mobile network users, to rise to the ongoing challenges of the pandemic.

When we kicked off the process for our 2020 awards, we certainly couldn’t foresee the scale of the changes that would befall our industry, and the whole world, by the time we announced the winners. Like so many organizations, we have adapted our interactions and events to an online environment, placing heavy demands on the very connectivity technology that we develop.

As always, the awards have been judged by a fiercely objective panel of industry analysts and experts, and this year, you will have the chance to hear directly from those judges about their views on the industry. The presentation of the awards will take place following a special in-depth session in which the judges will discuss the key developments they have observed in the past year and the most important trends going forward.

Every year there are more entries for our awards, which are regarded throughout the mobile industry as a prestigious badge of honor, selected with a rigorous judging process. We have had a record-breaking turn-out again — so many of our conversations throughout the year have focused on the extra mile that so many vendors and operators have gone to adapt to the effects of the crisis, and to help customers, partners and the wider community to do the same. Many of these efforts — and the ‘thinking out of the box’ that has gone into them — have been reflected in a diversity of interesting entries.

Diversity is a key theme of SCF’s work program in 2021, and also of the awards. This year, there are 10 main categories, plus some special awards, as usual. The categories have been reviewed and refreshed and some new additions are specifically designed to reward commercial success or innovative approaches by non-traditional deployers, service providers and vendors.

So, for instance, the awards for excellence in commercial deployment — always popular both with entrants and the wider industry — are now split between deployments by traditional mobile network operators, and those by alternative operators such as neutral hosts or private network operators. There is also an award for a technology, product or service that helps to enable diversification of the supply chain and lower barriers for models such as neutral host.

A very topical category will reward outstanding contribution to small cell open RAN platforms, which will be important enablers — at chip, network and software levels — to diversifying the supply chain and offering systems at all price points for different types of deployer. An important aspect of SCF’s contribution to the broader open networks push is to focus on common interfaces at silicon level and encourage a broad base of component makers, so it is appropriate that there is a new award this year, for an outstanding small cell chip or component.

Of course, some of the categories are familiar, maintaining consistency with previous years. One of the most interesting aspects of judging the awards, after more than a decade, is to see the changes in technology and business model that add up to a winner in long-standing categories such as outstanding small cell product and technology; outstanding software and services for small cell networks; or outstanding innovation in small cell business case. And then there is a category that has been unchanged since the very first SCF awards – for social, economic or environmental impact of small cells. This is a constant factor because it emphasises that a connectivity industry cannot be introspective, but must make networks and services valuable to communities everywhere, including the underserved, and must think in terms of global economic and environmental progress.

In 2021, this is more important than ever. I had hoped that we would be announcing the awards winners in a world that is moving back towards some measure of normality. However, if anything is to be learned from the pandemic in our industry, it is that affordable connectivity is a way to survive crisis, and our sector can thrive commercially while also promoting global progress.
C-RAN – REAL WIRELESS

C-RAN seems to have been a long time coming. Real Wireless CTO Simon Fletcher first started exploring the potential of C-RAN back in 2007. Since then there’s been a great deal of industry talk and thousands of pages of standards describing dozens of C-RAN architectures. And he’s still waiting.

In a sense we are all waiting for a slightly different version of C-RAN because, throughout its development, the term has become overburdened with the aspirations of an industry that knows that C-RAN can do things better but isn’t quite sure what better looks like.

Is C-RAN mostly about the Cloud? Or Centralization? Back in the mists of time, C-RAN was used to describe a Clean RAN, architectures heralding an era of green radio with environmental benefits. For more than a decade, C-RAN has been all this and more, which is why commercial implementations are always just over the horizon.

But if we take the term to describe architectures that centralise base stations to reduce capex, while driving network efficiencies and performance, then many would argue C-RAN has been a commercial reality for at least three years. For Asian operators like KDDI, for example, C-RAN as shorthand for centralized RAN is a tried and tested solution that means centralized base stations, deep fiber in metro areas, and radio heads hanging off that fiber to ramp up capacity in hotspots.

However, for those dreaming of cloud native C-RAN – constantly evolving functionality via software defined networks with access to unlimited on-demand compute – well, let’s just say it’s a work in progress and there’s still quite a way to go.

While the C-RAN concept can seem nebulous, few endeavours survive 10 years or more on hot air alone, there are, of course, real drivers behind the Cloud RAN (as opposed to cloud native RAN). Mobile operators in every market are looking to move away from hardware-based networks that tie them to particular vendors. They want to reduce the costs of network densification through commoditized, standardized, non-propriety kit, coupled with a shift to software architectures supporting network function virtualization (NFV).

NFV is a critical element in the realization of commoditized infrastructure. The idea is to employ standard IT technology to consolidate a wide range of network elements on to...
Providing breakthrough economics to enable the deployment of shared small cells in targeted locations, enhancing network performance and reach at cell edge locations. Using licensed neutral spectrum and a virtualized system we have created an access agnostic solution ensuring today’s 4G and future 5G networks can support increased demand and a variety of both private and public use cases.

THE TARGETED DEPLOYMENT OF NEUTRAL HOST SMALL CELLS OPERATING ON DEDICATED LICENSED SPECTRUM

Providing industry standard high-volume servers, switches and storage, which can be located in data centers, network nodes or at enterprise premises.

The drivers for the virtualization of cellular networks are well understood and pretty much the same as the ones that led to the transformation of data centers. The headline benefits are obviously reduced equipment costs and power consumption, through consolidating equipment and exploiting the economies of scale of the IT industry. But NFV also promises a less generic approach to service delivery, because the economies of scale required to cover investments in hardware-based functionality are no longer applicable in the context of software-based development. This is why Cloud-RAN is important for private cellular networks for enterprises. NFV means service providers (and this might include the enterprise itself) can tailor functionality to suit the needs of customers in ways that are impractical in the context of conventional cellular network architectures.

So why is it all taking so long? Well, different markets have different relationships with their legacy networks. In Asia – where operators have centralized via classic telco architecture that meets their immediate needs rather well – there has been understandable pushback to the adoption of standards describing the Cloud-based architectures promulgated by operators and vendors in the US and Europe.

As we have seen, many Asian operators have highly integrated base stations that don’t have virtualization as a capability. And they don’t need it. Their C-RAN networks have evolved over time and are based on an architecture of large base station ‘hotels’ situated in switching centers. Such service providers have little interest in the push from vendors to swap out equipment that performs perfectly well and exchange it for fancy new architectures that add nothing to the functionality or performance of the base station. They are unmoved by claims that cloud architectures will deliver advantages such as improved network sharing economies.

However, in Europe and the US many operators and vendors have embraced a Cloud-RAN vision of higher capacity base stations that can, in theory, be shared among a number of operators, while delivering efficiencies that enable a large number of resources to be available for transmission (trunking gain).

It should be stressed that all this is still largely theoretical. Real Wireless studied these architectural changes as part of the European Commission’s 5G NORMA project. The conclusion of the study was that the major architectural changes currently emerging from the standards were so significant that network design was indeed moving into the cloud native space. Which is another way of saying forget legacy architectures and re-imagine network design with a blank sheet of paper. Which is great, except… when you get a bunch of engineers in a room thinking about what can be done, complexity and a surfeit of blue-sky visions are just a few steps away, inevitably leading to higher cost and greater time to market acceptance.

Cloud-RAN was meant to be all about simplifying things, but the architectural changes described in the standards are becoming feature heavy and extremely complex. In addition, one of the main tasks of standards is to ensure the security and reliability of the systems. The
But despite the hardship that we have seen, one thing is clear from both a personal and professional sense — the country continues to move forward. Entire businesses have shifted to a remote set-up, grandparents are video-calling for bedtime stories and high-flying professionals are teaching Key Stage 2 Maths in between calls. With all that has happened, our connections to one another haven't diminished; they've shifted and even strengthened as we've realized the real value the power of partnerships.

The importance of the fundamentals

As an organization, we feel a deep responsibility towards keeping us all in touch with one another; it is the driving force behind everything that we do. After all, the network is what powers how we are communicating and has supported the UK’s shift to remote working over the last ten or so rollercoaster months.

From the core network and fiber through to mobile operators and the power for 3, 4 and now 5G connectivity, we sit at the heart of Britain’s infrastructure, investing into existing and new technologies to ensure the best possible service for all. This has led to the acceleration of some exciting new innovations as we look to support connectivity wherever it is needed. But this is not just new technology for the sake of it — it’s innovation with a purpose.

This brings us on to small cells, a cornerstone of our push to #connectforgood. Essentially small, low-powered cellular radio access nodes which are used both in busy, congested areas as well as in more remote locations where signal can be difficult. Small cells work alongside the classic radio layer of service to boost signals and ensure connections are available and maintained, whoever needs to use them, no matter their geography.

#Connectforgood in action

The beauty of small cell installation is that it is minimal enough to be tailored out of sight. From lampposts and phone boxes to the interior of buildings and the top of stadiums, small cells are the unseen helpers that are powering us towards new technologies such as the use of 5G, irrespective of the pandemic.

The nature of the cells and the importance of their use has been driven home over the last few months, as BT engineers have worked high and low — quite literally — in order to introduce or augment connectivity. Here are just some of the recent deployments carried out.

Hello Downing Street

Last month, we integrated an outdoor small cell with Nokia on Whitehall in Westminster, strategically located just outside the gates of Downing Street itself. Given the limited number sites in the vicinity, a high footfall due to tourists and surrounding government buildings, this is a very high-profile area on the junction of Downing Street and Whitehall. With government departments coordinating in their approach to reopen the country, this cell ensured a powerful signal throughout a busy area.

Ain’t no mountain high enough

Connectivity is just as important in hard-to-reach areas. As of June 2020, Ofcom reports that 91% of the country receives good 4G outdoor coverage from at least one provider, but that still leaves too many people going for a better connection.

So, stepping up to the plate was our engineering team in Scotland, who braved Ben Nevis in the middle of December, climbing away at the ice shrouding a cell site and relay for crucial repairs for our Scottish customer base.

Looking to the future

These are just two examples that showcase the versatile range of small cell and macro cell deployment, the different goals they can achieve and the variety of situations our staff can find themselves in on their quest to #connectforgood. Because whilst the country makes the best of remaining in one location for the time being, we at BT see our field force — and the new technologies they deploy — as the foundation for keeping us connected. Over the last few months, that has taken us onto the roofs of football stadiums, to the birthplace of Shakespeare and everywhere in between.

CONNECTIONS FOR A REAL DIFFERENCE, AT A CRUCIAL TIME

We have seen a full year since Covid-19 lockdown measures came into play in the UK, encompassing three national lockdowns and a variety of changes in the midst of them. It’s staggering how long this unnatural state of affairs has been going on for.

standards are meant to be the gold standard. This is important to the business case for cellular – especially in the enterprise. End-to-end security is one of the main advantages cellular has over Wi-Fi and the move to cloud-based systems threatens to compromise that advantage – for example, IEEE points to C-RAN vulnerabilities that include saved roping, denial of service and issues around authentication. All this and more is tackled as part of the standards development process, but it comes at a price. Security adds still more complexity in the interfaces of the system.

What’s really slowing everything down are too many iterations of the standards, too many options, and a process that’s building in too much complexity to the C-RAN concept. This is the inevitable outcome of too much group thinking that needs to be honed down through the move to cloud-based systems and an attractive ecosystem of handsets and devices.

In the immediate future, there’s going to be a fair deal of trial and error via early deployments where we’ll get to understand what’s really important in the delivery of stable and efficient architectures and which of the nice to haves are best stripped out. This is a well-worn but sometimes painful process, but the outcome will be simpler than the current standards might imply and, eventually, able to deliver the gold standard in terms of reliability and security that are the hallmark of cellular solutions.

Ultimately bells and whistles features can always appear exciting but are generally less important than the core functionality a firm or sector needs to meet its connectivity requirements. And businesses need to be able to reach decisions without absorbing thousands of pages of technology standards or evaluating dozens of marketing pitches. And while experts like Real Wireless can help support such decisions, the heavy lifting really needs to be done by the wireless industry itself in forging and committing to robust, practical and cost-effective C-RAN architectures that deliver end-to-end security, core and future-proofed functionality that meets business requirements and an attractive ecosystem of handsets and devices.

The importance of the fundamentals

As an organization, we feel a deep responsibility towards keeping us all in touch with one another; it is the driving force behind everything that we do. After all, the network is what powers how we are communicating and has supported the UK’s shift to remote working over the last ten or so rollercoaster months.

From the core network and fiber through to mobile operators and the power for 3, 4 and now 5G connectivity, we sit at the heart of Britain’s infrastructure, investing into existing and new technologies to ensure the best possible service for all. This has led to the acceleration of some exciting new innovations as we look to support connectivity wherever it is needed. But this is not just new technology for the sake of it – it’s innovation with a purpose.

This brings us on to small cells, a cornerstone of our push to #connectforgood. Essentially small, low-powered cellular radio access nodes which are used both in busy, congested areas as well as in more remote locations where signal can be difficult. Small cells work alongside the classic radio layer of service to boost signals and ensure connections are available and maintained, whoever needs to use them, no matter their geography.

#Connectforgood in action

The beauty of small cell installation is that it is minimal enough to be tailored out of sight. From lampposts and phone boxes to the interior of buildings and the top of stadiums, small cells are the unseen helpers that are powering us towards new technologies such as the use of 5G, irrespective of the pandemic.

The nature of the cells and the importance of their use has been driven home over the last few months, as BT engineers have worked high and low – quite literally – in order to introduce or augment connectivity. Here are just some of the recent deployments carried out.

Hello Downing Street

Last month, we integrated an outdoor small cell with Nokia on Whitehall in Westminster, strategically located just outside the gates of Downing Street itself. Given the limited number sites in the vicinity, a high footfall due to tourists and surrounding government buildings, this is a very high-profile area on the junction of Downing Street and Whitehall. With government departments coordinating in their approach to reopen the country, this cell ensured a powerful signal throughout a busy area.

Ain’t no mountain high enough

Connectivity is just as important in hard-to-reach areas. As of June 2020, Ofcom reports that 91% of the country receives good 4G outdoor coverage from at least one provider, but that still leaves too many people going for a better connection.

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These are just two examples that showcase the versatile range of small cell and macro cell deployment, the different goals they can achieve and the variety of situations our staff can find themselves in on their quest to #connectforgood. Because whilst the country makes the best of remaining in one location for the time being, we at BT see our field force — and the new technologies they deploy — as the foundation for keeping us connected. Over the last few months, that has taken us onto the roofs of football stadiums, to the birthplace of Shakespeare and everywhere in between.
OUT OF THE STARTING BLOCKS

The launch of smartphone devices with 5G spectrum bands will have a significant impact on network rollouts. And, whilst it is true that incumbent equipment vendors are shrinking in the marketplace, it is heartening to see the growth of open radio access network (RAN) development.

OPENING UP THE RAN – FROM INNOVATION TO POLICY

Radio access network spend is by far the largest portion of investment in any communication network. Open RAN is all about disaggregating the wireless access system. Splitting the RAN into well-defined, functional portions, with agreed interfaces, allows smaller players to enter the supply chain, resulting in more competition and faster innovation cycles. Evidence of this new ecosystem can be seen with Vodafone’s first Open RAN radio site in Wales, as well as the recently announced Telefónica/Rakuten partnership to increase economies of scale.

NEUTRAL HOSTS – A NEW BREED

A group of enterprises are emerging to serve 5G vertical industry segments. These range from system integrators, mobile network operators (MNOs) themselves, private companies running industrial networks, property companies, and neutral host service providers.

The open neutral host covers a wide variety of players, focusing on different market segments from rural networks and stadiums through to transport corridors or the ‘burbs’ of metropolitan areas using small cells.

BAI Communications, a leading global provider of neutral host communications infrastructure, specializes in connectivity in difficult-to-reach environments, such as underground tunnels or crowded city centers, where it makes more sense to deploy a shared network that can provide multi-MNO signals. This provides both logistical and cost benefits.

Neutral host providers, such as BAI, are also technology agnostic. This is because many technology variables come into play. By keeping the range of available technology options broad, we are able to provide a more effective solution.

Irrespective of technology, success also depends on building relationships, trust, and a collaborative spirit among stakeholders as we work towards mutual goals.

MAKING 5G SMALL CITIES A REALITY

A lot of effort has gone into analysing and developing 5G site cases for industry segments, mapping them against the various 5G functional drivers, such as high speed broadband, ultra-low latency and massive IoT.

BAI is particularly interested in the 5G outdoor neutral host space. Building on the city-wide transportation use case which has its own particular needs and challenges.

Different organizations, from mobile operators (MNOs) to cable providers to enterprise integrators, may identify their own return on investment (ROI) in individual scenarios. But it can be hard for a single service provider to identify sufficiently large revenues to justify their own build-out. Many enterprises, buildings and venues would get high quality cellular coverage far more quickly and easily if the service providers could reduce their risk and upfront cost by riding on a neutral host platform.

Conclusion

BAI’s annual Connectivity Outlook Report surveyed rail users across five major cities and connectivity that is fully tailored to their specific requirements.

A decade of studying business cases and gathering operator requirements has made it clear to SCF members that one deployment model does not fit all when it comes to small cell networks. This is especially true of enterprise and in-building cellular networks, because each industry, and even each location, has its own particular needs and challenges.

The success of this neutral host model relies on collaboration among stakeholders, from MNOs and neutral host providers to regulators, venues and local authorities.

By enabling business models, we can make a significant contribution to widespread connectivity in mass transport corridors, cities and dense urban environments both in the UK and globally. This will play a key part in the post-pandemic recovery. And more importantly, it is an exciting opportunity to provide lightning fast 5G connectivity, helping people move more safely, smartly and securely, and improving user experience.

This article first appeared in full on UK5G’s digital magazine Innovation Briefing.
ACCELERATING INNOVATION 
WITH OPEN RAN FOR SECURE, 
RELIABLE PRIVATE 5G NETWORKS

Airspan’s 5G end-to-end Open Ran ground-breaking and innovative solutions are the key to accelerating innovation, providing additional security, increasing reliability and improving performance for private networks.

Whether it’s high capacity, high security, or connecting a high number of critical IoT devices, deploying a local private network will ensure your operations run successfully, regardless of where it’s located (indoor, outdoor, underground, over water, etc.). It’s ideal for many industries, including ports, logistics, factories, event venues, fulfillment centres, public safety, utilities, healthcare, transportation, and more.

Real Flexibility with 
Cloud-Native Open Architecture

Enabling agility, Airspan’s OpenRANGE (Open RAN) software delivers standards-based solutions as defined by 3GPP, O-RAN and TIP.

Leading Global Customers:

Airspan is uniquely positioned with Open RAN, private networks, fixed wireless access (FWA solutions) and a pioneer in end-to-end Open RAN solutions interoperable with other vendors. As a result of our innovative technology and significant R&D investments to build and expand our 5G solutions portfolio, Airspan is a US-based provider of ground-breaking, disruptive software and hardware for 5G networks and a pioneer in end-to-end Open RAN solutions interoperable with other vendors. 

However, there are challenges for towercos to adapt to the in-building market too. There are significant practical and financial differences between a model based on a relatively small number of large assets such as towers, and one based on hundreds of thousands of sites. And neutral host small cell models do not always stop at the passive infrastructure — shared active equipment, as well as multi-haul links, will be important to make dense networks affordable and manageable in many scenarios. Most towercos will have to acquire new skills and processes, and adjust to new financial expectations, to play a role in active networks.

But the other is edge computing, which our research indicates will increasingly be built out hand-in-hand with localized cellular networks to support enterprise applications. Adding edge nodes, deployed at cell sites or enterprise premises, to the small cell and multi-haul portfolio can enhance the revenue model for neutral hosts and expand their ecosystem of partners and customers.

In the US, the three leading towercos — American Tower, Crown Castle and SBA — all have partnerships with edge platform-as-a-service and infrastructure-as-a-service (IaaS) providers such as Equinix and Vaporio. And in Europe, Celenx has announced an edge-centric alliance with Lenovo and NearbyComp to offer 5G-connected IaaS. In France, Celenx has also announced a joint venture with Bouygues Telecom to accelerate rollout of fiber to support dense 5G.

These multi-faceted alliances between towercos and enterprise-focused MNOs highlight the potential of the in-building neutral host market for towercos. As they can add more and more assets to their portfolios, spreading their bets and increasing their strategic importance to operators, the operators themselves can accelerate their expansion into enterprise cellular markets, often in conjunction with edge services, increasing their revenue potential while reducing their cost and risk.
The economics of deploying cellular networks at scale are increasingly challenging, as demands for higher data rates and better coverage go up, but user willingness to pay higher fees does not. This dichotomy is particularly wide in emerging markets, especially outside major cities, where the demand for wireless broadband is as high as anywhere else, but ARPU may be extremely low.

Yet there are increasingly pressing reasons to extend mobile broadband to populations that may still have only 2G access, or none at all. Some of these relate to government targets for digital inclusion and social justice; some to operators’ need to reach new users, as their established consumer bases become saturated.

But a very different approach to deployment needs to be taken if outdoor networks, in rural or suburban regions of emerging economies, are to deliver both the performance users require, and the profits operators need. This will rely far more heavily than previous cellular networks on asset sharing, as well as automation, but will also support a wide diversity of equipment and services.

Small Cell Forum believes it is crucial to define and promote these new approaches, to lower barriers to deployment of HetNets that can bring much-needed connectivity to millions of citizens and businesses. SCF has become the primary hub of activity to promote a diversity of deployment and management models, designed to transform the economics of dense network and to include a wider range of service providers in the ecosystem. This is particularly important in emerging markets, where traditional operators have often found high barriers to profitable build-out outside urban areas.

There are two secrets to the new approach to cellular build-out, and both are being driven particularly strongly from the small cell industry, and by activities within SCF.

One is diversity – a network that can be constructed from many different types of equipment, spectrum and sites, in order to support the widest range of applications and revenue streams at the most efficient cost.

Gone are the days when the only way to reach an underserved community was to invest in a macrocell, in sufficiently low frequency spectrum that it could cover many kilometers, and so reach enough people to turn a profit. A far better balance between performance and cost can be struck with a cluster of small cells, deployed so that...
The project 5G CONNI is part of a European-Taiwanese research cooperation with the aim to accelerate the validation of new 5G technologies for specific applications with special requirements (vertical use cases). Within this framework, the partners will work towards an international consensus on standardization, regulation and application requirements between the industries of both regions. The 5G CONNI project is funded by the European Union within the Horizon 2020 programme and the Ministry of Economic Affairs, R.O.C. (Taiwan) with approximately EUR 2 million each. The project will run for three years, starting on 01/10/2019.

Project Goal

Demonstration of 5G radio, network and cloud technologies as enablers for future Smart Factories by integrating private local 5G networks into a multi-site end-to-end industrial communication test-bed. Exploring new operator models, planning and deployment strategies for private 5G networks.

capacity is targeted where communities are based, rather than wasted on a huge area where many places are uninhabited.

These clusters can provide services to a village, a farm or a remote industrial site, and can deliver full broadband speeds and bandwidth. Their economics are improved by the flexibility they offer to deployers. SCF members have spent years developing many form factors, which can be mounted on all kinds of street furniture, low-level buildings or even underground, depending on site availability and the most efficient locations to deliver high quality connectivity.

Creating that cluster then enables operators to layer a diversity of revenue-generating services on top of the network, rather than being constrained, by a sub-GHz macrocell, to basic voice and data offerings.

Where there is wireline broadband access available, the services can include fixed wireless access and TV, making 4G (or future 5G) the only telecoms and media platform. That allows the operator to tap into users’ entire spend on these areas, rather than just mobile, which is important in low-ARPU areas.

Sharing infrastructure – sites, backhaul, power and other assets – can greatly improve the cost base and ROI for any small cell networks, but this is particularly true in emerging markets where margins may be very tight. Some regulators are starting to pressure, or even mandate, operators to build shared rural networks to reach underserved citizens. However, there are many voluntary and commercial arrangements which can dramatically improve the business case for operators and accelerate the launch of broadband services for citizens and businesses.

Sharing of underlying infrastructure is the starting point. Operators are becoming accustomed to sharing cell towers and accompanying power and backhaul resources, and the habit of building on sites that are run by a neutral host, or shared by several MNOs, is spreading to small cells.

In this segment, sharing can have an even more dramatic impact on the business case than in macrocells because of the sheer number of different sites that must be built out and maintained to support an industrial zone or even a rural community. Indeed, shared infrastructure is often the only way to make an outdoor small cell economical at any scale, reducing total cost of ownership by as much as five times, according to a survey of 40 cellular network deployers in Africa and emerging Asia.

This is not just about infrastructure sharing. The more the small cell industry cooperates on technical specs and management models, the lower the cost and time to deploy a network that can start to support services and revenue streams from day one. Under SCF’s auspices, technologies to enable open, multivendor networks, from chip to management layers, have been evolved over a decade. These are very important to increase competition and innovation in the industry and reduce TCO.
Radio Access Network technology is in transition. TMN’s Keith Dyer believes that the same holds true for small cells.

The wireless industry has been grappling with the move to 5G, with enabling open, virtual and cloud-based networks, and with delivering connectivity via new ownership models.

All of these, combined with the geo-political winds that have buffeted the sector, have made Open RAN the break-out RAN trend of 2020-2021. 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 an architecture that can enable them to deploy networks flexibly, with optimised placement of functions, and with scaleable 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 which small cell architecture will best fit the network densification or dedicated coverage you are hoping to deploy.

The next generation of LTE and 5G small cells will also 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.

A group within Small Cell Forum has spent time identifying and defining the different types of small cell that sit within the disaggregated architecture defined by 3GPP.

Vick 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.”
ABOUT NG-VOICE: WHO WE ARE AND WHAT WE DO

Our flagship product, ng-voice’s fully containerized and cloud-native IMS Core, brings a completely new approach to mobile infrastructure software. Based on Kubernetes architecture, with the smallest container size, high level of automation and efficient use of resources, our IMS Core is scalable, flexible, and easy to deploy and manage, allowing operators and enterprises to deploy innovative voice services on LTE/5G networks.

Our fully and cloud-native IMS Core

Based on Kubernetes architecture, with the smallest container size, high level of automation, and efficient use of resources, ng-voice’s IMS Core is 100% containerized and Kubernetes-based, allowing deployment on bare metal (private), public, and hybrid cloud environments. Following the best practices in CI/CD and bringing a DevOps approach to telecommunications software, all of ng-voice’s network components follow a microservice-based design and offer multiple deployment options based on Kubernetes. Due to the clever slicing of our services, the image size of our containers for our sub-environments, the high level of automation across the whole development, deployment and operation process. Minimal use of resources, reducing capital and operational expenditures and generating positive effects for the environment.

Our value proposition

ng-voice’s IMS Core is 100% cloud-native, cloud-agnostic, fully based on microservices, and containerized with the smallest container size, high level of automation and efficiency of resources, ng-voice’s solutions truly stand out, bringing possibilities for operators to innovate on voice services and reduce costs. Moreover, our IMS Core perfectly fulfills the needs of enterprises of all sizes, allowing them to build and operate their own 5G campus networks with autonomy and lower resources. The benefits of this innovation are:

- Possibility to deploy on bare metal (private), public, and hybrid cloud environments.
- High level of automation across the whole development, deployment and operation process.
- Minimal use of resources, reducing capital and operational expenditures and generating positive effects for the environment.
- Flexibility and reliability to scale up and down.
- Standard-compliance to 3GPP, being successfully integrated with all major suppliers (Nokia, Ericsson, Huawei, ZTE), allowing mix-and-match with legacy structure as well as innovative open-source applications.
- Faster time-to-market of new services and features.

Furthermore, ng-voice offers open-source expertise and a solution-oriented approach, being the right partner to develop your network in the long-run.

To find out more about our solutions, please visit www.ng-voice.com or get in touch via info@ng-voice.com.

Meet ng-voice’s fully containerized and cloud-native IMS Core and other mobile infrastructure solutions. Flexible, cost-effective and easy-to-deploy and manage, our solutions allow operators and enterprises of any size to deploy future-proof voice services on LTE/5G networks.

Rapid service delivery: reduces the time of deployment to less than a minute and optimizes the lifecycle management of the application.

Minimized resources footprint: it consumes – for an average enterprise network with a few thousand subscribers – only 2.5 vCPU and 3.1 GB of memory, which is 50x lower than competitors for the same amount of subscribers.

Flexible business model: our business model requires a low upfront commitment and adapts to customer’s growth in the long run.

She says that forming the definitions 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.

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, 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 interfaces 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 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”.

According to 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 (i.e. single split) option in those cases.

Small Cell Forum then produced a categorization of different definitions of small cell, focusing on the RU and DU elements (as the CU is often located in a centralized data center).
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 deployments. 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 the open SCF interface called 5G-nFAPI planned for indoor enterprise use cases.

As industry understanding of Open RAN evolves, we will likely see development of such solutions from a wider variety of developers and OEMs in the market.

This piece is excerpted from TMN’s Small Cells Market Update 2020.

Small Cells Market Update 2021 is now available at: www.themobilenetwork.com
NEW OPERATORS ARE POISED TO TRANSFORM THE ENTERPRISE MOBILE EXPERIENCE

Most enterprises and industries have aspirations to use cellular connectivity to support programs to make processes more digital and efficient, but too few can access networks which are fully reliable, let alone optimized for particular requirements such as low latency. Fewer than half of enterprises say that mobile quality of service is adequate, and only about 20% would trust cellular networks with critical communications.

Most enterprise networks are, of their nature, based on small cells, the majority inside buildings, so the small cell industry has needed to take the initiative in addressing this challenge. That, in turn, will be vital for 5G to deliver its full potential to enable enterprise transformation, as well as new revenue streams for established and new service providers.

There are four main developments that are at the heart of small cell industry efforts. If well supported by regulators, operators and the broader ecosystem, these will deliver high quality mobile connectivity – 4G and later 5G – to all kinds of industries and public sector organizations, in a way that is affordable both for the enterprises and the service providers. Those four enablers are:

- Spectrum and other support for greater diversity of operators to complement MNO activities, since MNOs often find specialized enterprise requirements are at odds with their business model. Alternative providers include private network operators, neutral hosts and enterprise integrators.
- Shared spectrum, a key factor in enabling new service providers and lowering barriers to entry.
- Self-contained small cell RAN and core technologies, often virtualized, are emerging, allowing enterprises and their partners to have full control of cellular connectivity, including aspects such as access control. New open architectures will further reduce costs and lower barriers to new providers.
- Co-investment across ecosystem will be essential, with the costs and rewards split between enterprises, operators and other partners.
These factors will be important drivers of densification in enterprise and industrial environments, and 80% of small cell deployments between 2019 and 2026 will be for these purposes.

There will be differences in how the networks are deployed and monetized, depending on the region, regulatory climate and vertical sector. We expect retail, government, transport, healthcare and hospitality to lead the way in overall adoption of small cell networks, and account for the highest cumulative deployments during the period between 2019 and 2026. But when it comes to private operators or other enterprise-specific providers – which will increasingly leverage shared spectrum, or millimeter wave bands – these will typically be focusing on sectors with demanding cellular requirements, which are particularly difficult for traditional MNOs to address. In terms of small cells deployed by alternative operators in shared or mmWave spectrum, the leading verticals will be manufacturing, transport, utilities and local government (mainly smart cities).

And while established MNOs will still command the largest installed base of enterprise small cells overall by 2026, in these challenging ‘non-carpeted’ industries, and in the shared or mmWave bands, private operators will dominate, and will drive much of the growth, innovation and diversification in the small cell business model, and in the mobile platform in general.
With a 20-year history, and more than 6M+ of Benetel designed radios deployed around the world, Benetel is meeting today’s challenges of virtualisation and disaggregation with leading-edge radio solutions for 5G disaggregated RAN and 4G/LTE Small Cells. Benetel is committed to supporting the evolving radio access networks around the world by producing Radio Units and related services that fully embrace the principle of openness. Working with leading vendors, partners, and open initiatives, such as the O-RAN ALLIANCE, the OpenAirInterface Software Alliance (OSA), and Telecom Infrastructure Project (TIP), Benetel is at the forefront of 5G radio technology. With its presence in many geographical markets, Benetel is collaborating with the key CU/DU vendors to ensure interoperability and end to end functionality.

Come talk to us.