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Small cells market status report

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Small Cell Forum accelerates small cell adoption to drive the wide-scale deployment of small cells and encourage the delivery of fully integrated HetNets.

We are a carrier-led organization. This means our operator members establish requirements that drive the activities and outputs of our technical groups.

We have driven the standardization of key elements of small cell technology including Iuh, FAPI, nFAPI, SON, services APIs, TR-069 evolution and the enhancement of the X2 interface.

Today our members are driving solutions that include small cell/Wi-Fi integration, SON evolution and automation, virtualization of the small cell layer, driving mass adoption via multi-operator neutral host, ensuring a common approach to service APIs to drive commercialization and the integration of small cells into 5G standards evolution.

The Small Cell Forum Release Program has now established business cases and market drivers for all the main use cases, clarifying market needs and addressing barriers to deployment for residential, enterprise, rural & remote, and urban small cells.

The Small Cell Forum Release Program website can be found here: www.scf.io

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Executive summary

This report summarizes the latest SCF *Small Cells Market Status Report*, which is based on surveys conducted in September and October 2018 by Rethink Technology Research. There were 98 respondents – 66 mobile network operators (MNOs), 32 other service providers – all members of an opt-in panel and with senior decision-making roles related to network deployments and strategy.

The panellists were asked about their firm's small cell deployment plans and business models to 2025. The results formed a primary input, along with other data points, to Rethink's small cell forecasting model. This was used to produce forecasts for 2017 to 2025, as well as identify significant enablers/barriers, and key use case drivers (see Chapter 6 for more details of the approach).

At the request of SCF members, in this year's update there was a particular additional focus on edge compute, neutral host and 5G trends in the small cell market. All the forecast results are available in Excel format to members in the Resources folder on the SCF Member site (please contact SCF member services if you would like to access this data).

This overview document highlights the most notable forecast results and the trends they illustrate.

Key findings – untapped potential

We modelled the best and worst case scenarios for non-residential densification by 2025, and found significant variation. The core forecast anticipates growth in new deployments and upgrades of 24% CAGR between 2017 and 2025, reaching a total of 8.4 million small cell radios deployed in 2025 across residential, enterprise, urban and rural/remote markets.

The best case scenario sees CAGR of 29% in the same period, reaching a 2025 total of 11.4 million; while the worst case sees CAGR of 22% and a 2025 total of 7.1 million. Therefore, if the drivers to densify prove stronger than our current assumptions predict – and/or the barriers that hold back deployment are lowered more rapidly than anticipated – by 2025 there is potential upside of 3 million units (compared to the base case). Conversely, if our worst case model proves correct, there will be a downside of 1.3 million (compared to the base case).

The decisive factors in play here were identified, by the service provider respondents, as those which would accelerate or expand deployment plans, and so push the forecast towards the best case. These factors are distinct in the indoor/enterprise and the outdoor/urban environments. In the former, the key factors relate to total cost of ownership (TCO), shared risk and ease of deployment/management. In the latter, the key factors relate also relate to TCO, but also to site issues, approvals, and deployment processes.

The regions which are already addressing such issues seriously are currently seeing the fastest growth, illustrating how critical it is that regulators everywhere follow their lead. These regions are North America, driven by the USA; and south east Asia, driven particularly by China and Japan. These two regions are expected to see non-residential CAGR of 92% and 74%, respectively, in the period from 2017 to 2019, compared to 68% globally. In these countries, significant effort has been made by authorities to

simplify approvals and deployment processes and lower barriers in cities, in particular. Assuming this progress continues throughout 2019, large-scale urban and enterprise projects will take place.

Other findings

Neutral host will be an important enabler of densification, especially for industrial and enterprise use cases and IoT. It addresses many of the challenges of scalability, TCO and shared risk and ownership, as identified by respondents, by allowing multiple providers to roll out services on a single set of infrastructure.

There will also be some move to enterprises, or their integrators, deploying private cellular networks within their own premises, in shared spectrum such as the USA's CBRS band, in their own dedicated spectrum, or via a spectrum partnership with an MNO.

One driver of the neutral host or private enterprise models will be convergence of small cells with edge compute nodes, which will support new use cases, especially in low latency IoT applications, and drive additional monetization opportunities for dense networks.

Another stimulus for densification will be the advent of 5G, which will take place in tandem with further enhancement of LTE capacity and coverage. This will be most clearly seen in outdoor deployments.

After a first wave of 5G deployment, largely based around macrocells and advanced MIMO antennas, there will be a rapid move towards selective densification in areas of high usage, and to support low-latency services in cities or industrial locations. In the enterprise, where densification has accelerated earlier than outdoors, there will be a greater tendency to enhance LTE further and achieve return on investment, before moving to 5G at scale.

The uptick in 5G small cell deployment will be heavily correlated to the availability of virtualized and disaggregated architectures, which will be a catalyst for 5G densification because of the greater cost efficiency and flexibility enabled. Combined 4G/5G small cells will be very important in deployment patterns, especially in virtualized environments. Virtualized clusters of small cells will be slow to take off in 4G, but this seems set to become the dominant architecture in 5G.

Contents

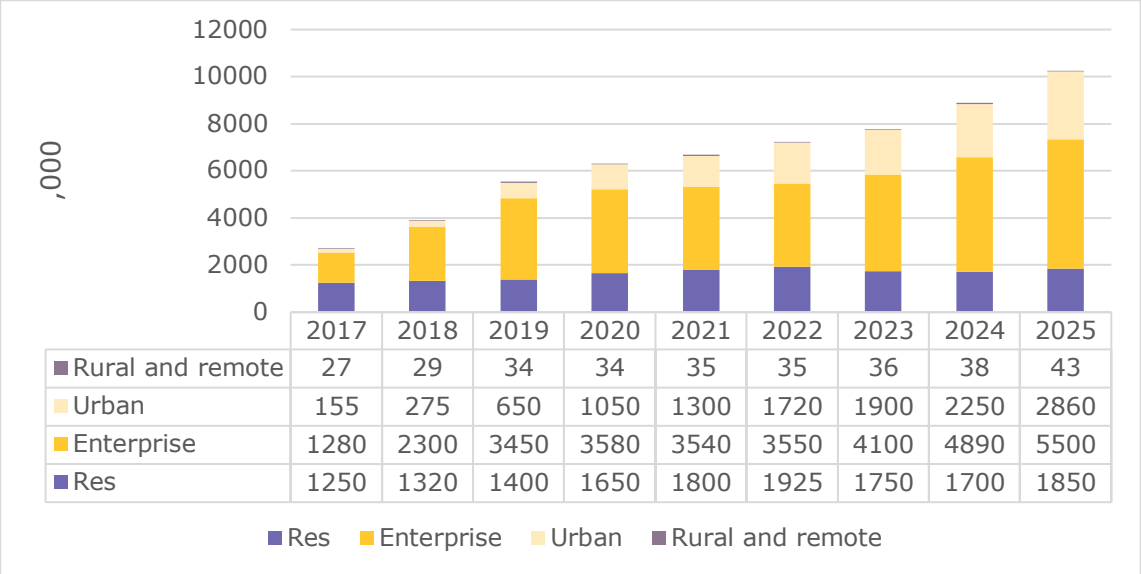
Figures

1. Densification forecast 2017-25

Our core forecast shows significant growth in densification in the period to 2025, driven especially by the urban and enterprise markets, which will enjoy CAGR of 44% and 20% respectively, across the whole period. There is a rapid burst of growth up to 2020, largely driven by very large projects in cities and enterprises in selected markets such as China and the USA.

In the first years of the '5G Era', 2020–22, growth will level off somewhat. This is because those early, at-scale projects will be finishing, and operators considering new large projects will be more inclined to wait until 5G equipment is fully available and affordable. From 2022, there will be a higher growth curve again, as 5G becomes more mainstream and as new capabilities emerge to support new or enhanced business models – for instance, low latency in Release 16 standards, enhanced security architectures, and edge compute platforms.

By 2025, we forecast deployments and upgrades reaching 10.25 million radios, with 8.4 million being non-residential. The largest sector, by that date, will be enterprise with 5.5 million units, followed by urban, with deployments of 2.86 million.



	2017	2018	2019	2020	2021	2022	2023	2024	2025
Rural and remote	27	29	34	34	35	35	36	38	43
Urban	155	275	650	1050	1300	1720	1900	2250	2860
Enterprise	1280	2300	3450	3580	3540	3550	4100	4890	5500
Res	1250	1320	1400	1650	1800	1925	1750	1700	1850

Figure 1-1 New deployments and upgrades by environment 2017-25

Deployments at this rate will add up to an installed base, by 2025, of about 40.2 million small cells across all environments, a CAGR rate of 46% since 2017. As Figure 1-2 shows, the fastest growth in total base will be in the urban environment, which will reach 11.2 million units by 2025, while in the same year there will be a total base of 28.6 million enterprise units.

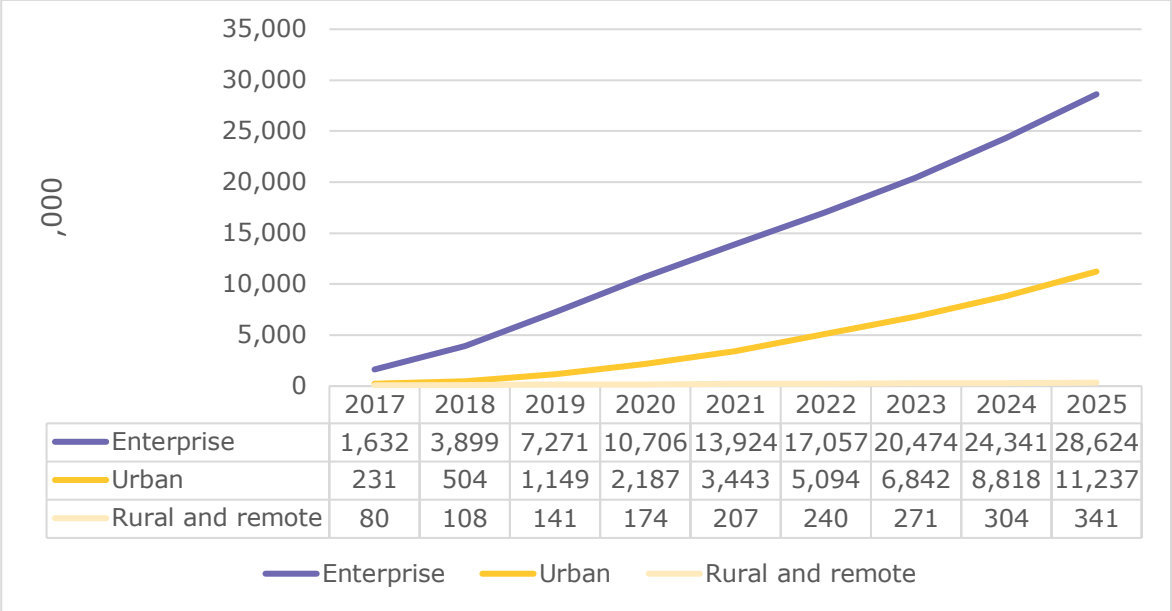


Figure 1-2 Installed base by environment 2017-25

The global forecast was broken down in various ways, including regional (see Chapter 5). Here we highlight two important aspects of the forecast, from the point of view of the densification landscape development as a whole.

One is the different pattern of deployment between indoor and outdoor cells. The majority of non-residential indoor small cells are in the enterprise environment, though these may be public-facing (e.g. retail malls), or mainly supporting private enterprise activities. They are currently normally deployed and operated by MNOs, but in future we expect to see diversification of the operating models, which will be particularly apparent in the indoor and enterprise environments (see Chapter 6).

Outdoor cells are mainly serving MNO-deployed, public networks in urban, suburban or rural environments, though a subset of outdoor cells will be dedicated to a particular enterprise (e.g.in the remote category, an oil rig or power station). In the 5G Era, when more small cells will be related to industrial and IoT (Internet of Things) services, there will be more vertical-specific cells deployed outdoors, sometimes managed by enterprise specialists.

In other words, over the period, the lines will blur somewhat between indoor/enterprise and outdoor/public network. We believe, therefore, that it is important to model indoor/outdoor patterns as those develop, especially because they involve very different challenges and drivers.

In the outdoor environment, growth rate will be double that of indoor during the period of this study – 41% versus 20% - but from a lower starting point. By 2025, indoor deployments will reach 5.6 million and outdoor will reach 2.76 million.

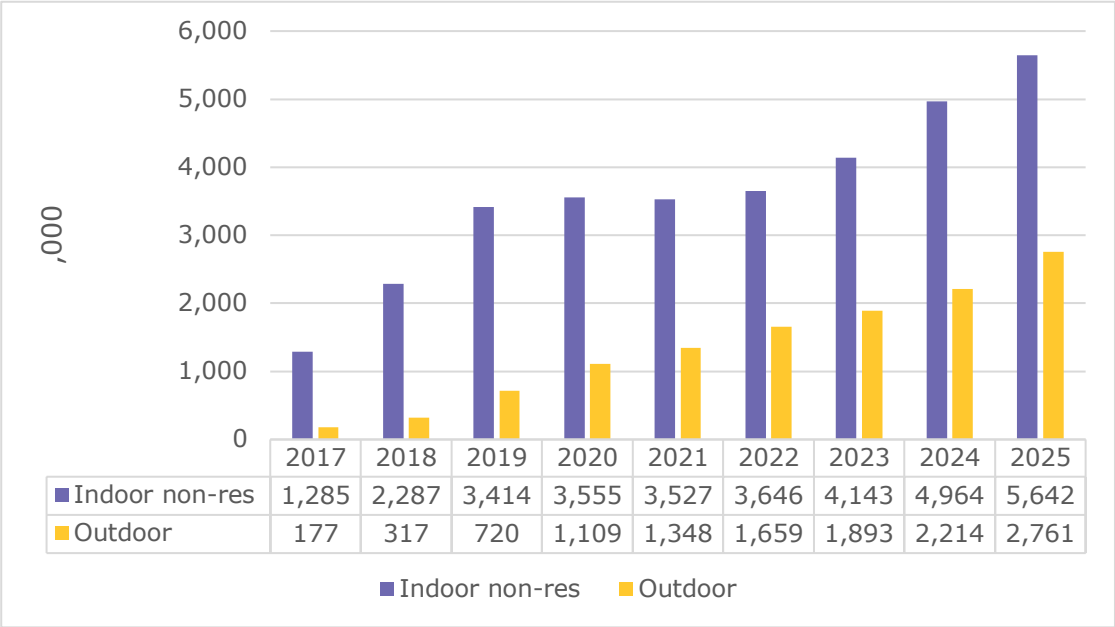
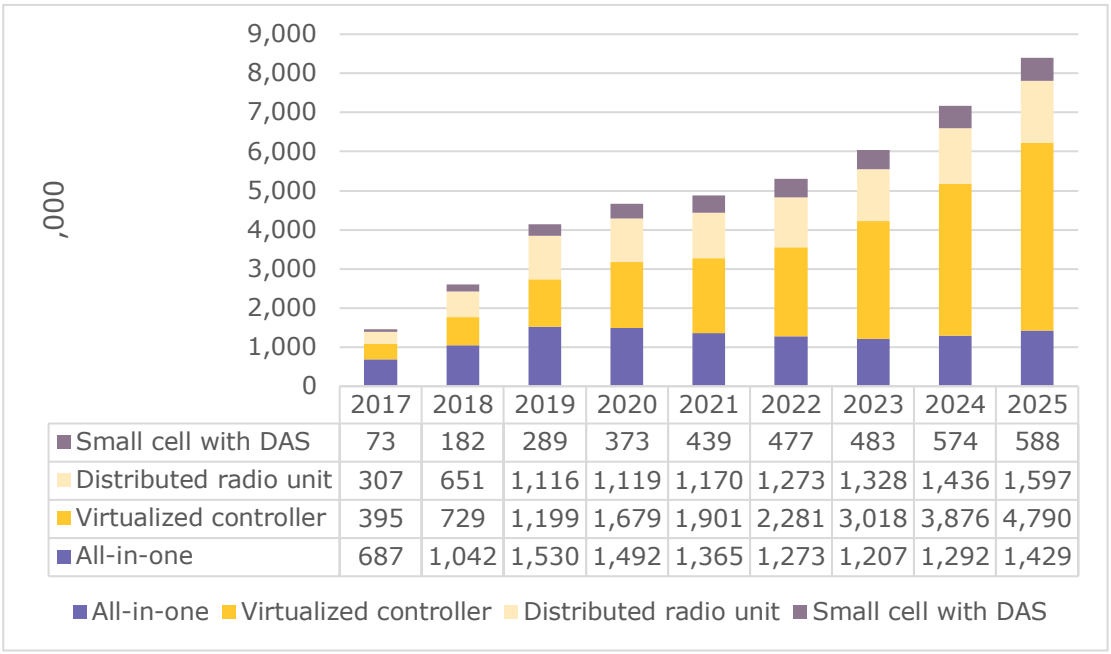


Figure 1-3 New deployments and upgrades, indoor vs outdoor 2017-25

Another important split is by architecture. The dominant small cell architecture, until the end of 2020, will remain the conventional all-in-one cell. However, various trends will drive new form factors, including more distributed or disaggregated designs. The need for discrete or compact cells for urban or indoor environments, and the emergence of 'mini-macro' products (macro equivalent cells in compact formats mountable on street furniture) are examples.

Increased numbers of cells within small areas will also drive new architectures based around shared controllers, to increase flexibility and reduce cost and total footprint. And with 5G will come a significant increase in adoption of virtualized small cell networks, with clusters of radios supported by a central controller, with some or all baseband tasks running as a virtual network function.

Virtualized systems will achieve the highest CAGR, at 37% across the period of the study, and will be the biggest category of new deployments from 2021, reaching almost 4.8 million radio units in 2025 (the figure refers to the radio heads, not the central controllers).



	2017	2018	2019	2020	2021	2022	2023	2024	2025
Small cell with DAS	73	182	289	373	439	477	483	574	588
Distributed radio unit	307	651	1,116	1,119	1,170	1,273	1,328	1,436	1,597
Virtualized controller	395	729	1,199	1,679	1,901	2,281	3,018	3,876	4,790
All-in-one	687	1,042	1,530	1,492	1,365	1,273	1,207	1,292	1,429

Figure 1-4 New deployments and upgrades of small cells, by architecture 2017-25

2. Which factors might change the 2025 outcome?

We modelled the best and worst case scenarios for non-residential densification between 2017 and 2025, and found a significant variation. A key element of these forecast variations was to model the impact of 10 key factors, which the operator panel identified as being particularly important ones that might accelerate densification, or slow it down, in the coming 3-5 years.

Those factors were identified, by the service provider respondents, as those which would accelerate or expand deployment plans, and so push the forecast toward the best case. These factors are distinct in the indoor/enterprise and the outdoor/urban environments.

In the former, the key factors relate to total cost of ownership (TCO), shared risk and ease of deployment/management. More than 40% of respondents said that lower operating costs, and a clear framework for sharing cost and risk between the operator and the enterprise, were top three factors. The better those issues were addressed in the coming years, the more they would feel able to accelerate or expand their deployment.

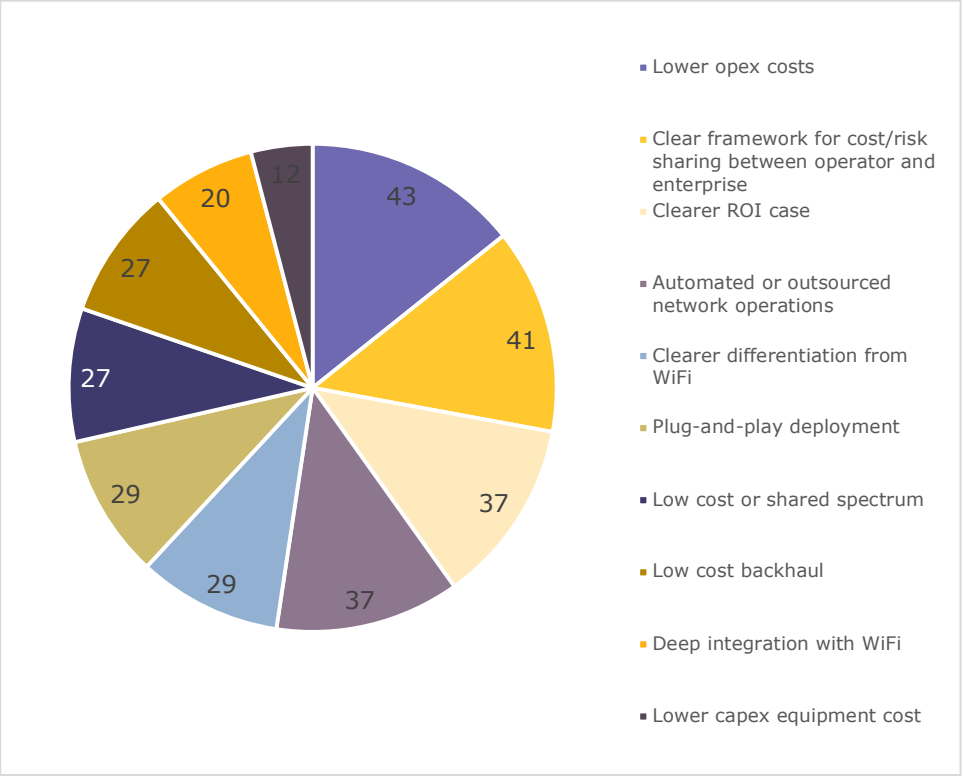


Figure 2-1 Top 10 factors which would accelerate or slow down deployment of dense networks indoor (% of 98 service providers placing each factor in their top 3, in terms of significance for pace of deployment)

Other important factors, placed in the top three by at least 25% of respondents, were a clearer return on investment (ROI) case for small cells; cost reduction through a greater ability to automate or outsource operations (and so reduce staffing); clearer differentiation of services or experience from already-installed WLANs; plug-and-play deployment, to reduce cost and time to implement; lower cost backhaul options; and

the ability to use shared spectrum, to have the flexibility to deploy without an MNO agreement.

In the outdoor environment, the key factors also related to TCO, but these were more often connected to site issues, approvals, and deployment processes. More than half of respondents said access to affordable sites was a top three factor which could accelerate or delay their current plans.

More than 40% selected lower operating costs for the entire deployment, or standardized processes for site and deployment approvals. The fourth most-cited factor was affordable backhaul, followed by frameworks to share costs with other parties (other operators, cities or enterprises); and a plug-and-play deployment process.

As in the indoor space, shared spectrum; neutral host or outsourced network operations; and higher degrees of automation were seen as enablers of faster progress with densification. In both environments, capex costs were at the bottom of the top 10 factors.

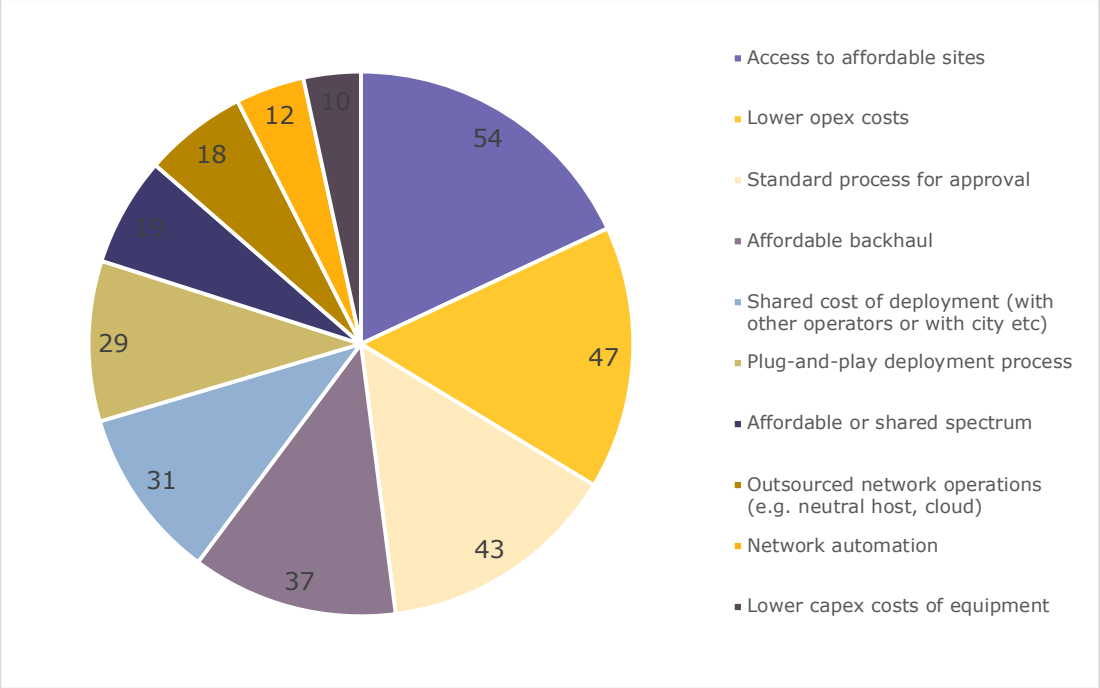


Figure 2-2 Top 10 factors which would accelerate or slow down deployment of dense networks – outdoor (% of 98 service providers placing each factor in their top 3, in terms of significance for pace of deployment)

We made best and worst case assumptions about how quickly and effectively these enabling factors will be addressed. Based on that modelling, we produced the best and worst case forecasts.

The core forecast anticipates growth in new deployments and upgrades of 24% CAGR between 2017 and 2025, reaching a total of 8.4 million small cell radios deployed in 2025 across residential, enterprise, urban and rural/remote markets. The best case scenario results in CAGR of 29% in the same period, reaching a 2025 total of 11.4 million; while the worst case sees CAGR of 22% and a 2025 total of 7.1 million.

That would translate to a total non-residential installed base, by 2025, of 50.1 million cells in the best case, and 35 million in the worst case.

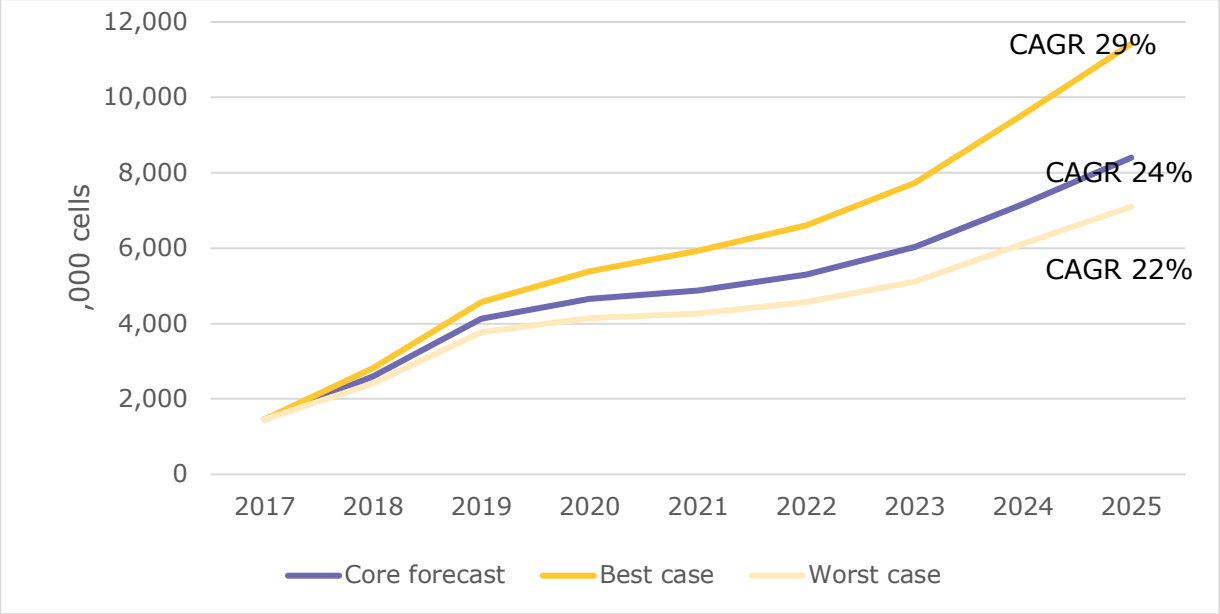


Figure 2-3 New deployments and upgrades of small cells by environment 2017-2025 – best case, worst case and core scenarios

Therefore, if the drivers to densify prove stronger than our current assumptions predict; and/or the barriers that hold back deployment are lowered more rapidly than we currently expect, by 2025 there is potential upside of 3 million units compared to the base case. Conversely, if our worst case model proves correct, there will be a downside of 1.3 million compared to the base case.

This shows that we see more potential for upside than downside. In other words, we believe operators are still being relatively cautious about their small cell expectations and are unlikely to deploy at a radically lower rate than they currently anticipate. By contrast, there is considerable untapped potential which would be released should certain factors come into play.

The potential upside/downside is greatest in the urban environment, because there are considerable risks associated with sites and city regulatory issues. If those issues are addressed, significant pent-up demand would be released, but in some regions, there remains a high risk that the barriers will be slow to come down. An associated risk is that, if urban challenges take a long time to address in some regions, operators will turn to alternative densification approaches, based around technologies like massive MIMO. These alternatives are far less relevant in the indoor environment.

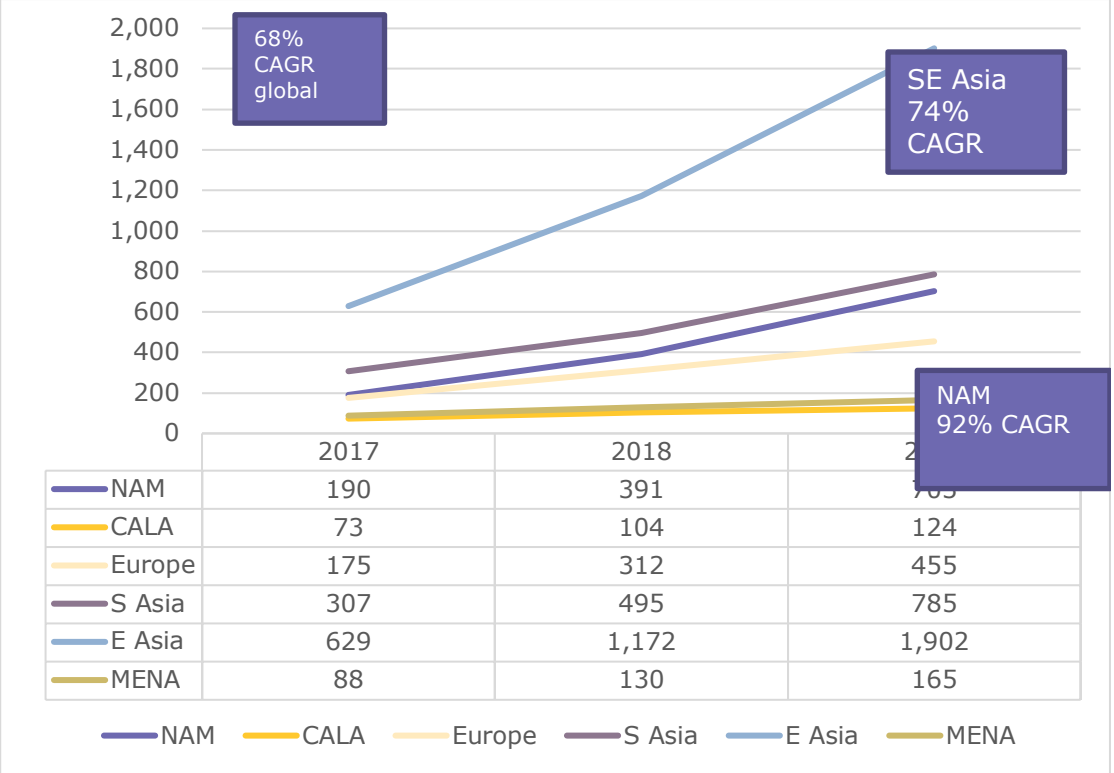
3. Some regions are already addressing these key issues

The regions which are addressing those factors most quickly are already seeing the fastest growth, illustrating how critical it is that regulators everywhere follow their lead.

These regions are North America, driven by the USA; and south east Asia, driven particularly by China and Japan. In these two regions, we expect to see non-residential small cell CAGR of 92% and 74%, respectively, in the period from 2017 to 2019, compared to 68% globally.

In these countries, significant effort has been made by authorities to simplify approvals and deployment processes and lower barriers in cities, in particular, while operators have been highly active in working with partners, and lobbying regulators, to make it easier for them to deploy small cells at scale.

Assuming this progress continues throughout 2019, large-scale urban and enterprise projects will gather pace in these key markets.

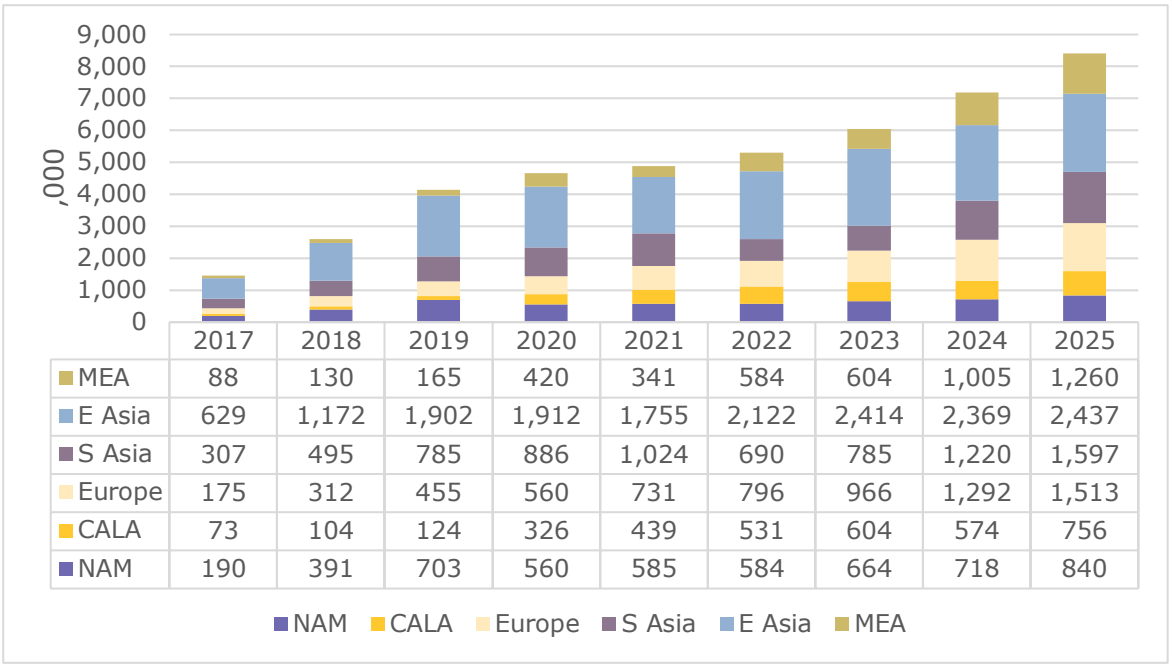


	2017	2018	2
NAM	190	391	
CALA	73	104	124
Europe	175	312	455
S Asia	307	495	785
E Asia	629	1,172	1,902
MENA	88	130	165

Figure 3-1 New deployments and upgrades of small cells, by region 2017-19

These areas of early, at-scale densification will build a strong base for 4G and 5G expansion, which will continue to generate high growth in the early 2020s. By 2022-23, we expect Europe and Latin America to be experiencing a higher rate of deployment, having been slower to lower key barriers than the early leaders. By this stage, South Asia, especially India, will also be a significant element of the market. Indian operators have been early to recognize the benefits of small cells, and to trial or deploy some innovative platforms, but several regulatory and commercial barriers will need to be addressed in the early 2020s for this market to reach its full potential.

By 2025, according to the core forecast, south-east Asia will still be deploying the largest number of new or upgraded cells, with 29% of the total, but that will be a lower percentage than in the early years of the forecast, when this region accounted for up to 455 (of a smaller base). South Asia and Europe will reach similar levels of new deployment by 2025, and will be followed by Middle East and Africa, driven by the start of at-scale deployments in some key African markets, such as South Africa, Nigeria and Kenya, from about 2024.



	2017	2018	2019	2020	2021	2022	2023	2024	2025
MEA	88	130	165	420	341	584	604	1,005	1,260
E Asia	629	1,172	1,902	1,912	1,755	2,122	2,414	2,369	2,437
S Asia	307	495	785	886	1,024	690	785	1,220	1,597
Europe	175	312	455	560	731	796	966	1,292	1,513
CALA	73	104	124	326	439	531	604	574	756
NAM	190	391	703	560	585	584	664	718	840

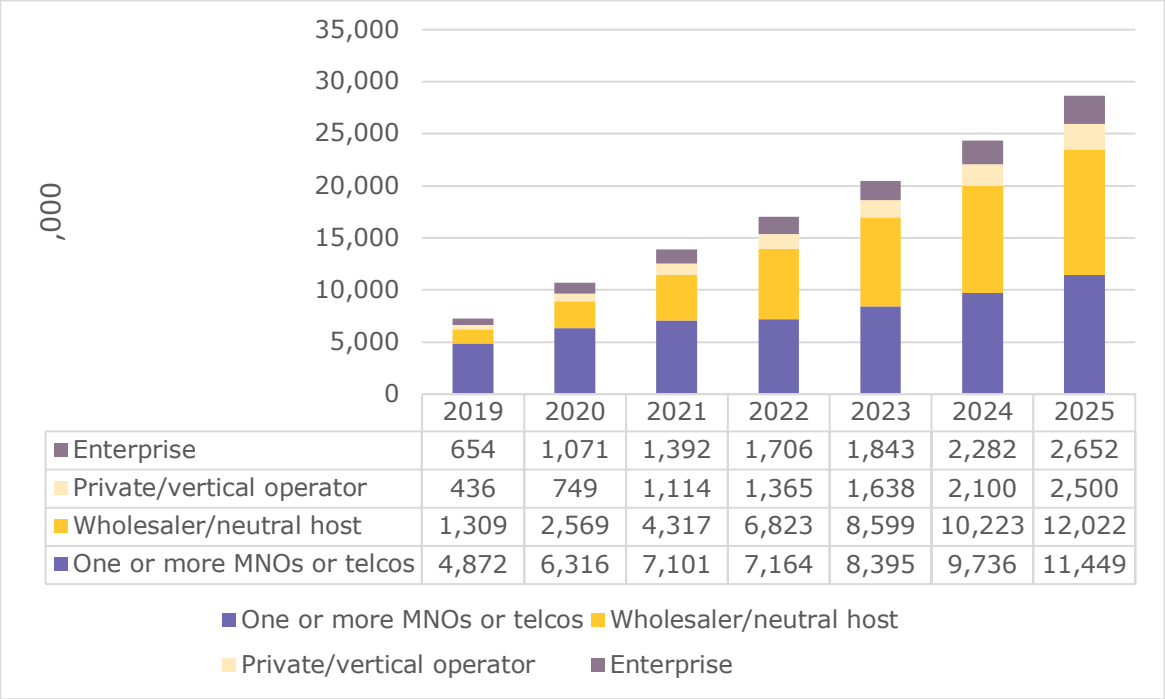
Figure 3-2 New deployments and upgrades of small cells, by region 2017-25

4. Neutral host and edge are important drivers

As highlighted in the earlier section, one of the enablers of accelerated deployment would be a way to reduce cost, risk and management effort by sharing the investment in small cells with others (between enterprise and service provider, or between multiple operators, for example). New deployment and ownership models are starting to emerge, to achieve some of these aims, and some will be accelerated by trends such as shared spectrum and the need for mobile networks which are specifically optimized for a particular vertical industry or use case. In the latter case, the relevant sectors may be willing to co-invest, as some utilities and industrial players are doing in Japan and China.

An approach which is attracting strong interest is neutral host deployment of dense infrastructure and multi-operator small cells. Many service providers, including enterprise specialists as well as the MNOs, are then able to share this network in order to deliver different services. The cost for each operator is greatly reduced and there is less pressure on sites and backhaul, and less risk of interference.

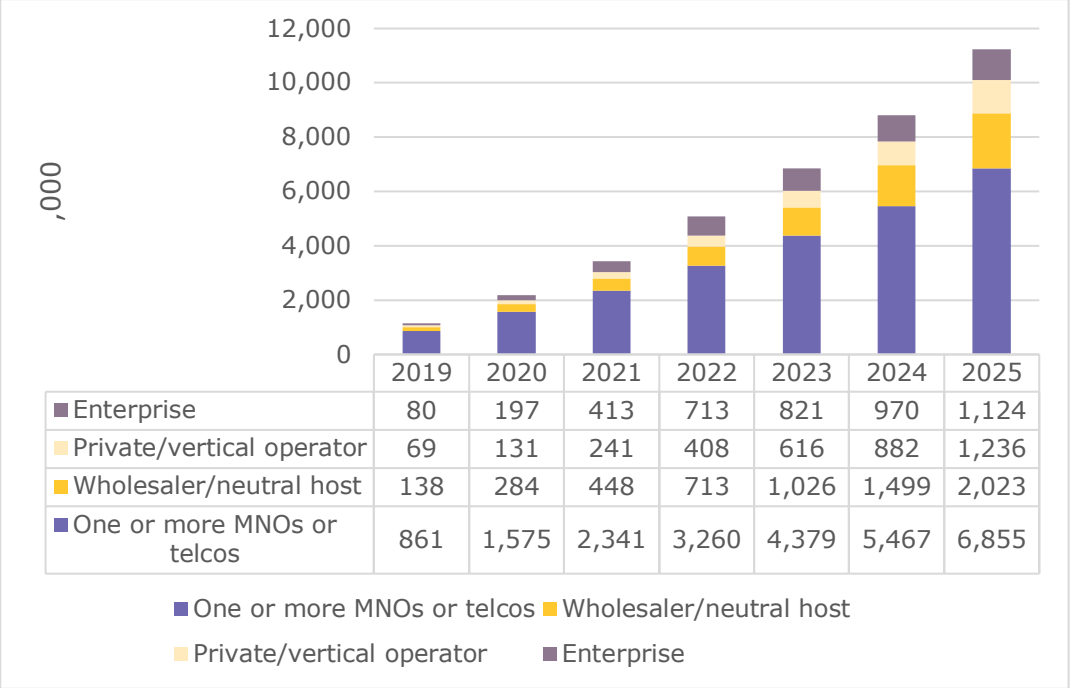
We predict this will be an important element of the densification landscape. In the enterprise, shared and neutral host networks will be the largest section of the market from 2023, narrowly overtaking the conventional MNO-driven model (including multi-MNO sharing) in 2023. Other approaches include the enterprise running its own network, in shared or MNO spectrum, and a private cellular operator providing a localized, self-contained network, often with its own local core.



	2019	2020	2021	2022	2023	2024	2025
Enterprise	654	1,071	1,392	1,706	1,843	2,282	2,652
Private/vertical operator	436	749	1,114	1,365	1,638	2,100	2,500
Wholesaler/neutral host	1,309	2,569	4,317	6,823	8,599	10,223	12,022
One or more MNOs or telcos	4,872	6,316	7,101	7,164	8,395	9,736	11,449

Figure 4-1 Installed base of enterprise small cells by ownership 2019-25

Outdoors, the MNOs will maintain ownership more commonly, but their networks will be supplemented by a rising number of cells deployed by industrial players or vertically focused neutral hosts, often to support 5G industrial and IoT use cases.

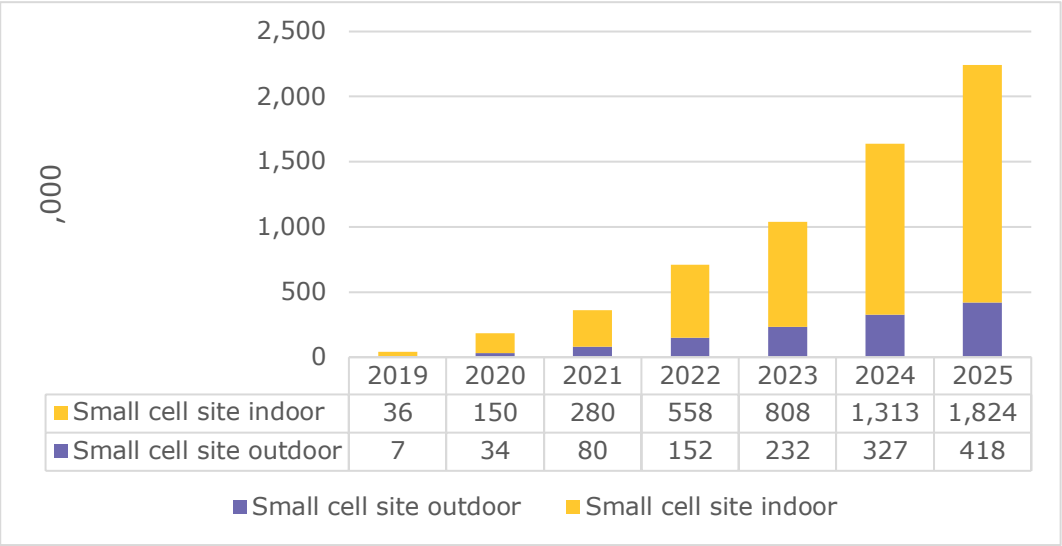


	2019	2020	2021	2022	2023	2024	2025
Enterprise	80	197	413	713	821	970	1,124
Private/vertical operator	69	131	241	408	616	882	1,236
Wholesaler/neutral host	138	284	448	713	1,026	1,499	2,023
One or more MNOs or telcos	861	1,575	2,341	3,260	4,379	5,467	6,855

Figure 4-2 Installed base of urban small cells by ownership 2019-25

An important driver of densification, especially towards the later years of the forecast period, will be the growing requirement for edge compute. That will initially be related to telco sites such as macro cell sites, but as the definition of the edge changes – with different applications and different industries requiring edge compute capability closer and closer to their premises and their users – there will be a natural convergence with small cell sites to provide advanced connectivity.

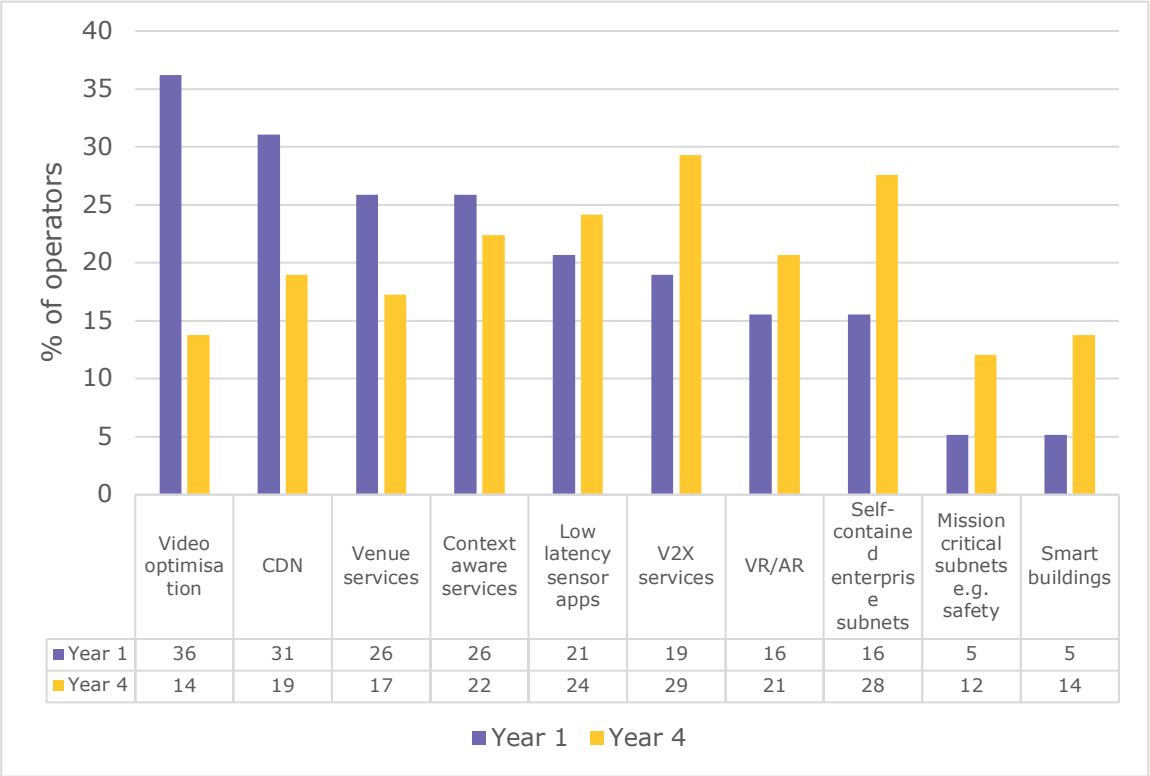
There will be almost 100% growth in the deployment of small cells collocated with edge compute nodes, from 2019-25.



	2019	2020	2021	2022	2023	2024	2025
Small cell site indoor	36	150	280	558	808	1,313	1,824
Small cell site outdoor	7	34	80	152	232	327	418

Figure 4-3 Edge compute nodes collocated with service provider small cells 2019-25

This will be driven initially by conventional MNO use cases such as improved video streaming, enabled by lower latency and localized caching. However, later the main drivers will be to support enterprise and industrial use cases with far more demanding latency requirements, and with rising requirement for localized edge/connectivity resource to ensure high degrees of security and data privacy. Figure 4.4 shows the main use cases which operators expect to prioritize for edge/connectivity deployments in the first three years of such a roll-out, and years 4-6, with a shift towards more enterprise, mission critical and ultra-low latency applications.



	Video optimisation	CDN	Venue services	Context aware services	Low latency sensor apps	V2X services	VR/AR	Self-contained enterprise subnets	Mission critical subnets e.g. safety	Smart buildings
Year 1	36	31	26	26	21	19	16	16	5	5
Year 4	14	19	17	22	24	29	21	28	12	14

Figure 4-4 What two use cases would you expect to be the primary use case to drive multi-access edge computing in year 1 of deployment, and in year 4? (respondents named all their target use cases. They were then asked to select two from a list of top 10

In enterprise environments, neutral hosts will be the most common deployers of these connected edge compute nodes after 2021.

This is because there will be many nodes deployed in non-telco locations, such as data centers and enterprise premises, some of which an MNO may add to its edge cloud by direct deployment, or via a leasing, sharing or swapping arrangement with another provider. These nodes may be connected by the MNO's cellular network, or to private cellular local RANs.

The issue of whether to deploy a large proportion of edge infrastructure itself, or rely mainly on third party sites, is an important one to ROI and the business model, but many operators increasingly expect to extend their edge virtually, especially in the enterprise, by riding on neutral host deployments of localized small cell + edge networks, and connecting these local zones via their wide area mobile network, and potentially offering added value services such as end-to-end security, or virtualized connectivity between enterprises driven by software-defined network (SDN) technologies.

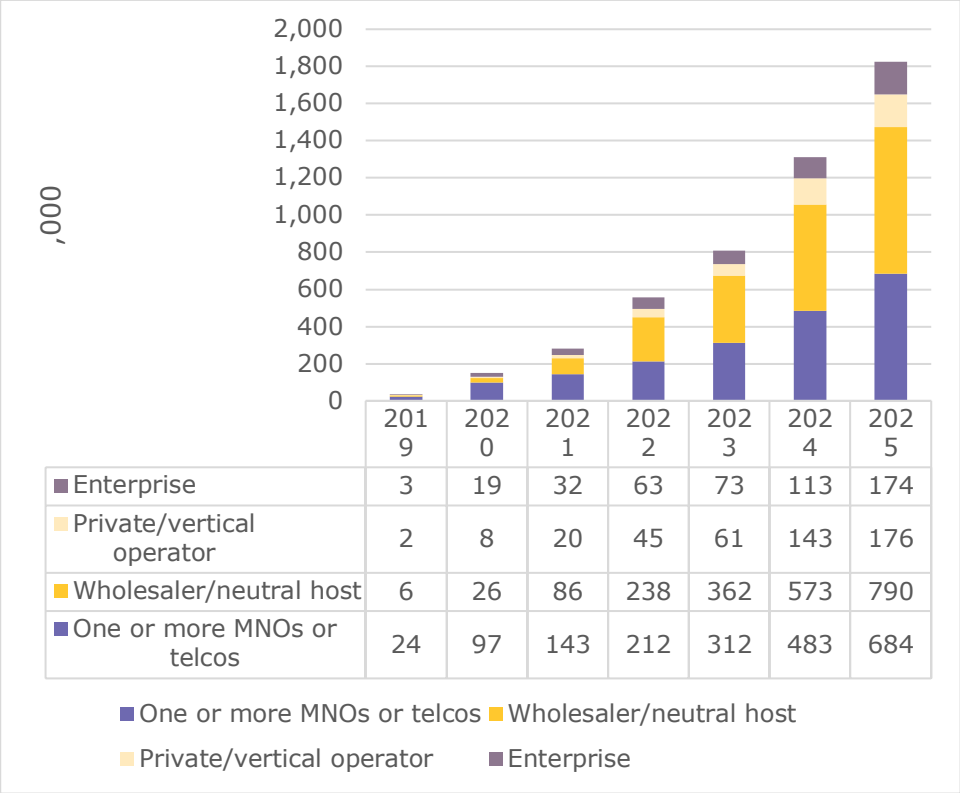


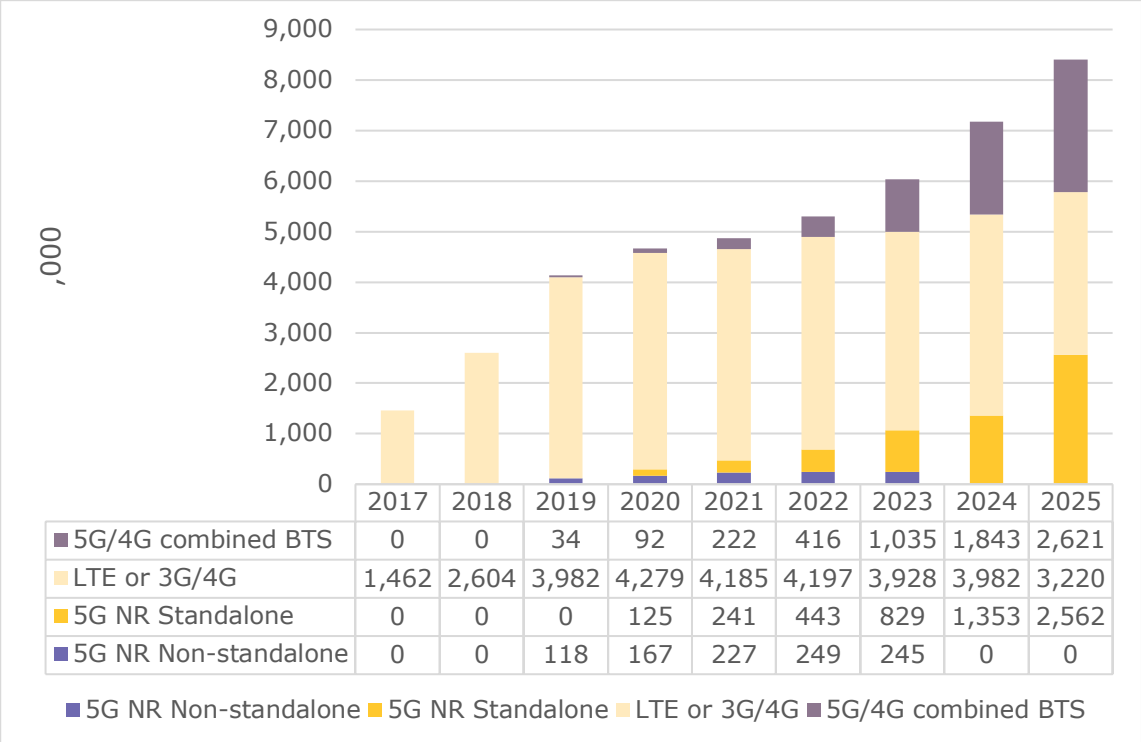
Figure 4-5 Small cells collocated with edge nodes by ownership – enterprise

5. What is the impact of 5G?

5G will be a catalyst for densification, because its deployment will often be driven by the need for targeted capacity, to enhance mobile broadband experience and support high device densities; and from 2020 onwards, by IoT and industrial services which require far greater coverage in-building and in remote areas. 5G will be a particularly strong driver in the outdoor market, mainly from 2021 onwards. National objectives for 5G leadership will sometimes push regulators and governments to lower barriers for deployment in environments like smart cities.

Combined 4G/5G small cells will be very important in deployment patterns, allowing operators the flexibility to combine existing and new connections, especially in virtualized environments. Integrated or collocated 4G/5G cells, including central controllers with a combination of 4G and 5G radio heads, will grow at more than 100% CAGR from 2019 to 2025. While virtualized clusters of small cells have been relatively slow to take off in 4G, in 5G they will be the dominant architecture.

Figure 5-1 shows that the 5G new radio non-standalone (NSA), which works with the 4G core, will drive early deployments but will be overtaken by the standalone variant in 2021. Despite the strong growth in 5G small cells – 80% CAGR in the forecast period from 2019 to 2025 – LTE densification will continue. Many operators will deploy 5G for selected locations or applications, and continue to add 4G capacity elsewhere; in some markets, 5G will not start to be deployed at all until the mid-2020s but additional 4G coverage and capacity will still be required. 5G or multimode deployments and upgrades will only overtake non-5G (mainly 4G, with some 3G/4G) in 2025.

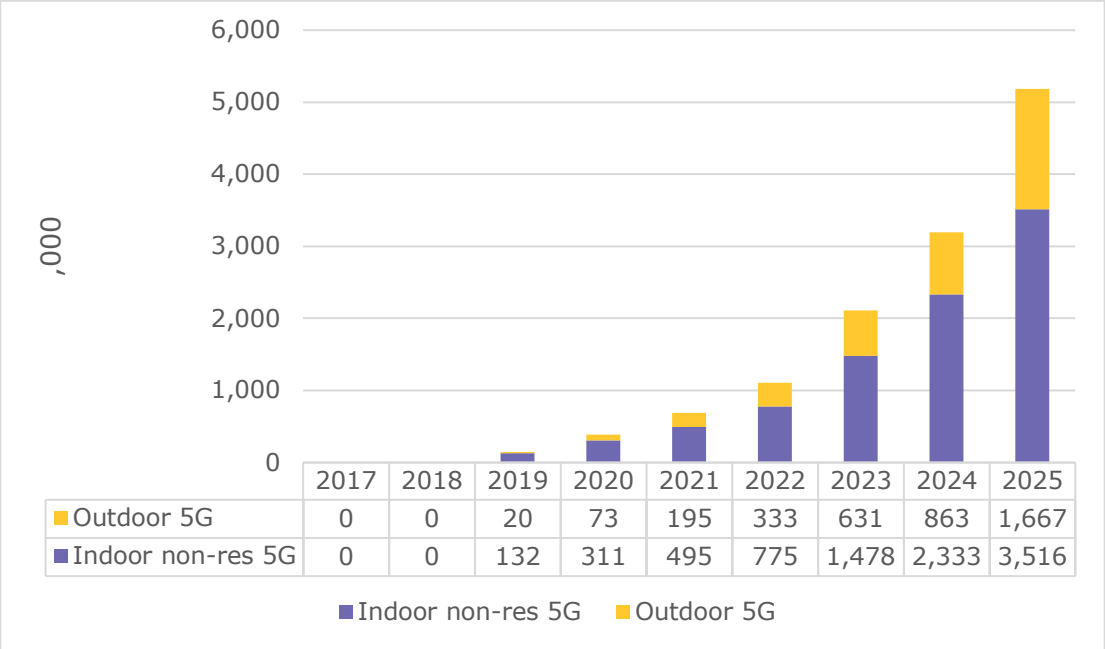


	2017	2018	2019	2020	2021	2022	2023	2024	2025
5G/4G combined BTS	0	0	34	92	222	416	1,035	1,843	2,621
LTE or 3G/4G	1,462	2,604	3,982	4,279	4,185	4,197	3,928	3,982	3,220
5G NR Standalone	0	0	0	125	241	443	829	1,353	2,562
5G NR Non-standalone	0	0	118	167	227	249	245	0	0

Figure 5-1 New deployments and upgrades of small cells, by radio technology 2017-25

As stated above, outdoor deployment will have proceeded more slowly than indoor in the early years of the forecast, but will be boosted by the advent of 5G, especially the common MNO practice of deploying 5G first in higher band spectrum, and to add dense capacity to areas of high usage, to support new experiences such as augmented reality gaming.

Although indoor deployments will be larger in number of radio units, in the outdoor environment, CAGR in 2019-25 will be over 100%, while for indoor deployments it will be 73% in the same period. However, indoor small cells will end up with a larger rate of deployment overall, at 3.5 million radios in 2025, compared to 1.67 million outdoors (Figure 5-2).



	2017	2018	2019	2020	2021	2022	2023	2024	2025
Outdoor 5G	0	0	20	73	195	333	631	863	1,667
Indoor non-res 5G	0	0	132	311	495	775	1,478	2,333	3,516

Figure 5-2 New deployments and upgrades of 5G or multimode 4G/5G small cells, indoor vs outdoor, 2019-25

In architecture terms, 5G will mark far higher rates of adoption of emerging virtualized platforms for small cell networks. Between 2019 and 2025, deployments of this architecture will grow by 99% CAGR, compared to 57% for all-in-one units and 66% for distributed radio designs without virtualization (usually NFV-based). Virtualized systems will account for two-thirds of deployments in 2025.

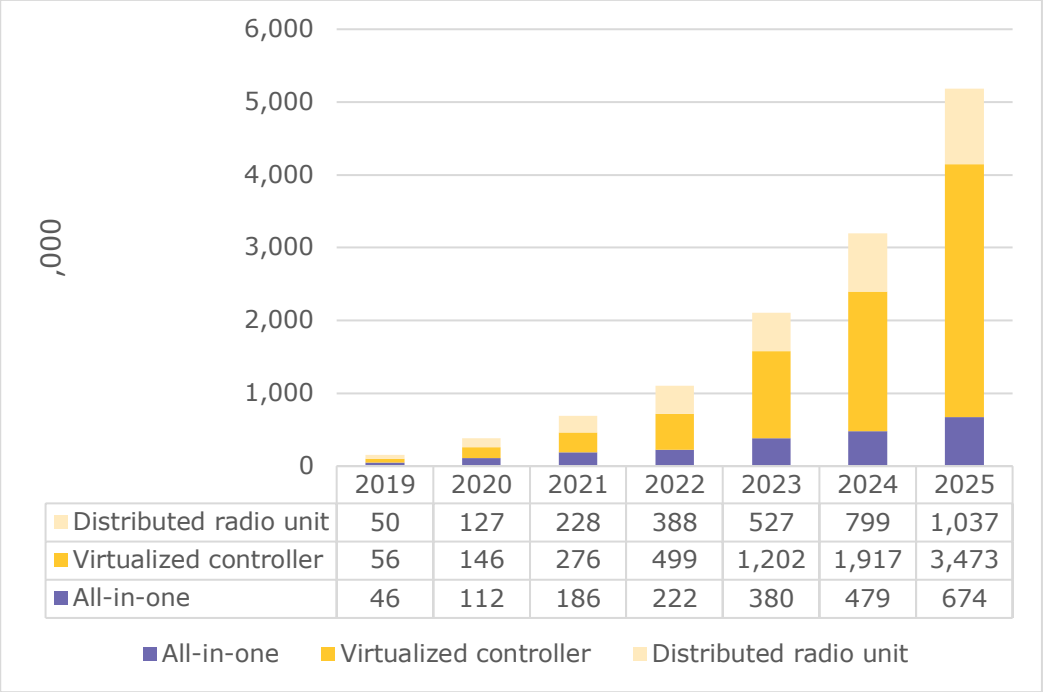


Figure 5-3 New deployments and upgrades of 5G and 5G multimode small cells, by architecture 2019-25

6. Methodology

The SCF *Small Cells Market Status Report* is based on surveys and forecasts conducted by Rethink Technology Research on a twice-yearly basis.

The most recent survey attracted response from 98 organizations. These consisted of:

- 68 mobile-only or fixed/mobile operators, in tiers 1 and 2, from a global base.
- 32 other organizations planning or deploying cellular networks including neutral host providers, private network operators, cable and fixed-line operators.

The respondents are members of an opt-in panel which Rethink has been recruiting since 2004 to study many aspects of cellular network deployment and business case. All respondents are pre-qualified and typically have senior executive roles in the networks or CTO functions.

The survey included questions about:

- Current deployment of small cell networks
- Estimated deployment of small cell networks by year, over the coming five years
- Breakdown of those deployments by spectrum band; radio technology; indoor/outdoor; public/private; architecture
- Current and planned deployment of edge compute nodes, collocated with small cells
- Business model for deployment (e.g. densification of macro network, enterprise network, neutral host)
- Drivers and barriers to deployment – what factors would accelerate or delay their planned deployment plans, or encourage them to deploy small cells for the first time?

All responses are provided with guarantee of anonymity but responses are analysed by region, operator type etc.

The responses provide key inputs to Rethink's proprietary forecast model. This also includes other data and metrics which will affect the forecast, such as:

- past history of actual deployment (9 years' history)
- expected availability of different kinds of spectrum by region
- expected regulatory and other government decisions by region
- expected availability of new technologies and standards
- vendor expectations for adoption patterns etc

Depending on whether these developments occur earlier or later than expected, (or not at all), best and worst case scenarios are identified in terms of quantity and timing of deployments.

In the most recent survey, the survey identified the top 10 enablers which operators believe would accelerate their plans if implemented. These have been included in the model to identify a best case (if all the key enablers are implemented in the short term), and a worst case (if none of them is implemented in the short term).