

Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

**HEAVY
READING**
**WHITE
PAPER**

5G Deployment & Service Strategies: An Operator Survey

A Heavy Reading white paper produced for InterDigital

INTERDIGITAL®

AUTHOR: GABRIEL BROWN, PRINCIPAL ANALYST, HEAVY READING

INTRODUCTION & KEY FINDINGS

In all major global regions, advanced operators are preparing for 5G service launch. After an intense effort to develop specifications and technology, and following extensive field trials, the industry now has a reasonable view of how the initial generation of 5G products and services will look and is in a position to move forward with confidence. The big unknown is just how far this new technology will scale in terms of new and diverse service types, and in its capability to radically reduce unit costs.

This report presents the results of an operator survey conducted in the summer of 2018, on the outlook for 5G network deployment and service innovation. The survey was open to employees of communications service providers only.

Key Findings – 5G Service Launches Are Imminent

- **Operators see 5G as an extension to their 4G network and service portfolio.** The largest respondent group (38%) describes 5G as "evolutionary to 4G," whereas one fifth (21%) say 5G will be "disruptive and innovative." This view is supported by later questions on expectations for 5G services, with many respondents saying their 4G and 5G service portfolios will initially be very similar.
- **5G is (very nearly) ready to go live. A full 70% of respondents expect to launch commercial service between 2018 and 2020.** The largest number (47%) say this will be an "initial commercial launch," which implies limited device availability or restricted coverage. A smaller but not insignificant group (23%) say their company expects a "mass-market commercial launch" in this timeframe. How one interprets "mass-market" vs. "initial launch" leaves scope for confusion; however, we believe the language is clear enough, and that the 47% group is most representative of launch plans in advanced markets.
- **Over a five-year view (2018-2023), the survey foresees a wholesale transition to 5G.** A full 71% of respondents think 5G will be a mass-market service by this time. This represents a major change in the mobile network landscape and underlines how important 5G will quickly become to hundreds of millions of customers.
- **There are striking differences between the U.S. and the rest-of-world (RoW) response in several key areas.** A majority (52%) of U.S. respondents think "faster end-user speeds" will be the most important commercial benefit of 5G within the three years of commercial launch, compared to just 16% of RoW respondents. The leading response from RoW respondents is the 41% that identify "new services and ecosystem expansion" as being the primary commercial benefit over the same timeframe.
- **A majority of U.S. respondents (59%) expect their company's 4G and 5G service portfolio to be "very similar," compared to just 25% of RoW.** By contrast, a strong majority of RoW respondents (67%) say although the 4G and 5G portfolios will be similar, there will nevertheless be "some 5G-only services." This isn't a radical disparity, but it does perhaps reflect a difference in tone between global regions.
- **Sentiment toward network slicing is positive overall.** Within three years of commercial launch, a majority (53%) of respondents say their company plans to deploy end-to-end slicing for "key vertical customers," and a further 18% plan an "extensive deployment" by that point. A not-inconsequential 24% expect to make only "limited use" of slicing.

-
- **A majority of respondents agree that a 5G core is required to offer the full range of 5G services.** However, the largest group (49%) agree "somewhat," whereas a smaller 28% agree "strongly." This introduces nuance to the discussion, because it implies that some respondents believe that important aspects of future 5G services might be supported in a 5G radio access network (RAN) connected to 4G core.
 - **Many observers, including Heavy Reading, expect that operators with plans to launch 5G in the next two years or so will do so using a Long Term Evolution (LTE) host network in non-standalone (NSA) mode.** The respondent base, however, is not so certain. A solid 29% expect to launch using NSA, but 38% say they are "undecided and considering both options," and a further 11% outright say they "don't know." Although it differs from our expectations, this is a reasonable view, in that the outlook for 5G core migration *is* uncertain.
 - **We asked respondents when they expect to migrate to a full, standalone (SA) 5G system architecture using a 5G core.** This is useful to know because it is at this point that advanced services, such as end-to-end network slicing, can be introduced. More than one third (37%) say they expect to migrate to SA mode within two years of commercial launch, which is an ambitious target, but plausible. Another 39% think it will take longer to migrate to the full 5G system architecture.
 - **The overall picture is one of uncertainty about the outlook for the deployment of the full 5G system architecture.** It is notable that 3GPP specifications for the migration from NSA to SA were not finalized at the time the survey was fielded, and that they remain uncertain at the time of writing. In the meantime, some operator respondents are bullish, some less so. Both positions make sense and are not necessarily contradictory.

Background to This Study

The questionnaire used in this study was written by Heavy Reading in association with Inter-Digital. The online survey was promoted by email to our service provider databases and garnered 87 responses from individuals working at communications service providers. Non-operator responses and other spurious respondents were deleted from survey and are not included in the results. All responses are confidential.

Close to half (54%) of the respondents were from U.S. operators, with Europe (17%) and Asia/Pacific (15%) as the next largest regions. At several points in this report, we contrast the "U.S. view," as expressed through the survey, with a RoW view. More than two thirds (68%) of respondents work for operators with more than \$500 million in annual revenue; operators with revenue of \$1 billion to \$5 billion were the largest group (26%), and those with more than \$10 billion in revenue were the second largest (24%). The respondent base was technology-aware, with 43% identifying as working in network planning and engineering roles, 18% in R&D and technical strategy, 14% in corporate management and 12% in IT and cloud roles.

The nature of this respondent base – predominantly individuals working in technical roles for large operators in advanced markets – inevitably impacts the results. It is probably best to think about the survey as giving an aggregate insight into how these types of operators are thinking about 5G, with the caveat that many countries – for example, in high-growth emerging markets – may be some way behind the deployment schedules and service expectations revealed through the survey.

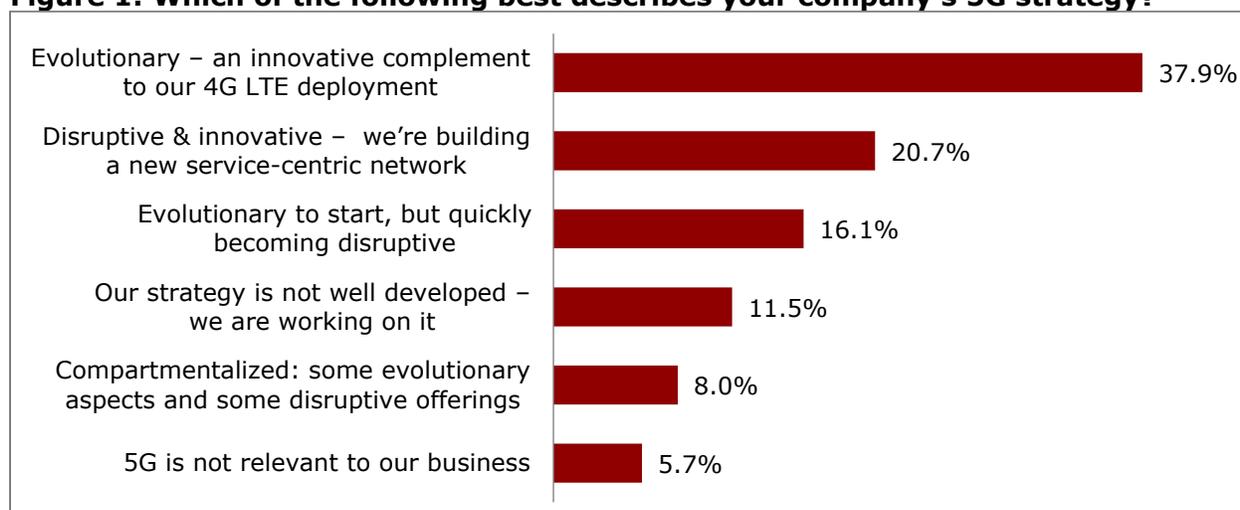
5G LAUNCH STRATEGY

The first part of the survey focused on launch plans and the outlook for services. Overall, the response showed that operators are now past the "vision stage" of 5G, where they make the case for investment based on the long-term potential of the technology, and on commercial opportunities driven by entirely new use cases and customer types. Instead, they have become arch-pragmatists, focused on what is achievable in the near term. New, advanced services remain important, but the optimal deployment strategy appears to be investing now in near-term mobile broadband capabilities, with a view to new services over the long term.

5G Is an Evolution of 4G-LTE

Quite clearly, operators see 5G as an extension to their 4G network and service portfolio. **Figure 1** shows that 38% of respondents describe 5G as evolutionary to their 4G deployment; a significantly greater score than any of the other options. On the other hand, a fifth (21%) say 5G will be "disruptive and innovative," and one might argue that in combination with the 16% who say 5G will be "evolutionary to start but will quickly become disruptive," this skews the response toward a view of 5G as "disruptive and innovative." However, while we agree this is part of picture, we nevertheless believe the 38% is the dominant response and is closer to operator sentiment in the second half of 2018.

Figure 1: Which of the following best describes your company's 5G strategy?



Source: Heavy Reading 5G Survey (n=79)

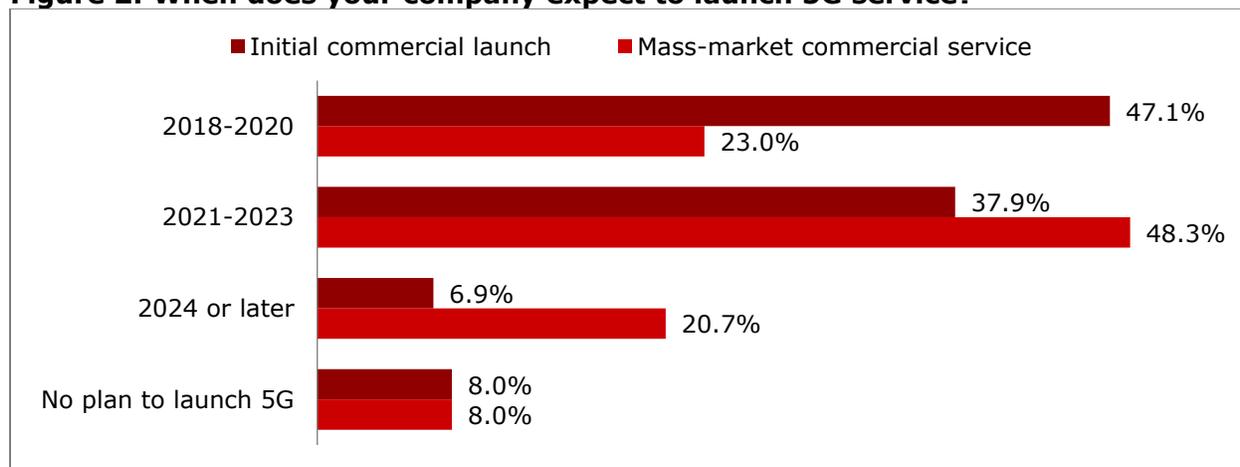
5G Is Imminent

In the time since the survey was conducted, Verizon has launched its 5G Home fixed wireless service commercially. One might argue that this is a fixed service based on the 5GTF specifications, rather than a mobile service based on 3GPP specifications; nevertheless, it shows commercial launches are imminent.

Figure 2 shows that a full 70% of respondents expect to go live between 2018 and 2020. The largest number (47%) say this will be an "initial commercial launch" – which would typically imply limited device availability or restriction to a few markets/cities – while a smaller group (23%) expects a mass-market commercial launch in this timeframe. Clearly,

how one interprets "mass-market" vs. "initial launch" is important to this question and leaves scope for confusion; however, we believe the language is clear enough, and that respondents in the larger group (the 47%) are most representative of launch plans in advanced markets. More broadly, these findings align with public statements from operators on expected launch dates.

Figure 2: When does your company expect to launch 5G service?



Source: Heavy Reading 5G Survey (n=79)

U.S. respondents are more bullish on 5G launch in 2018-2020 than RoW respondents. The U.S. response was 51% "initial launch" and 28% "mass-market"; in the RoW, those figures were 42% and 18%, respectively. Again, this is consistent with public commentary on investment plans by U.S. operators. Europe and Asia both contains pockets of bullish sentiment, but without the "all-in" mentality being as pervasive as it is in the U.S.

Over a five-year view (2018 to 2023), the regional differences even out, and the survey foresees a wholesale transition to 5G. **Figure 2** shows that 71% (48% plus 23%) of respondents think 5G will be a mass-market service by 2023. This represents a major change in the mobile network landscape and underlines how important 5G will quickly become to hundreds of millions of customers.

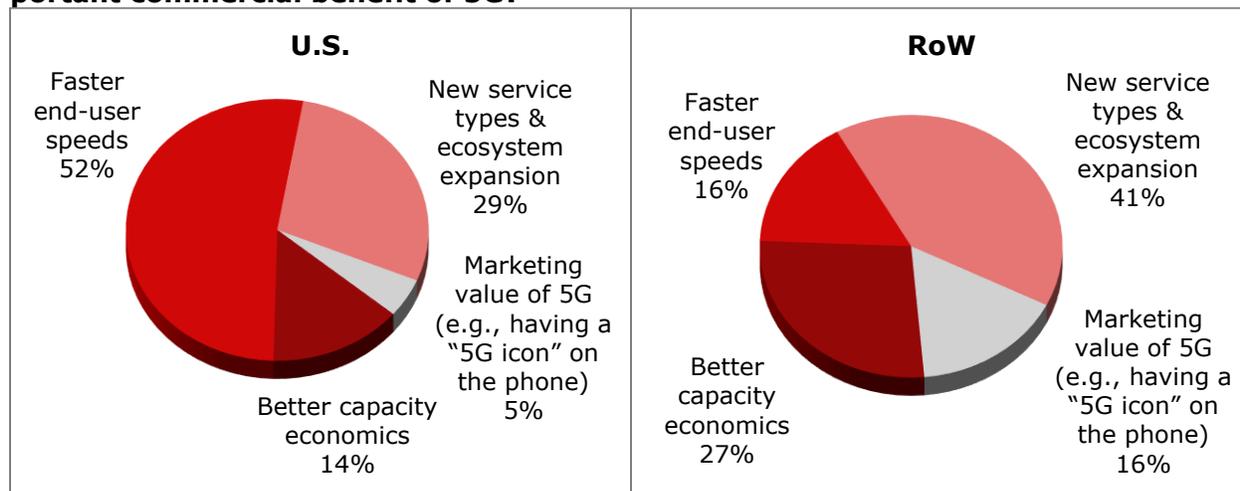
Pragmatism vs. Aspiration

A striking difference between U.S. and RoW expectations is revealed by the question on the commercial benefit of 5G. **Figure 3** compares the responses of each group and shows that a majority (52%) of U.S. respondents think "faster end-user speeds" will be the most important commercial benefit of 5G within three years of commercial launch, compared to just 16% in RoW. This difference possibly reflects received wisdom in the U.S. broadband market that "speed sells." 4G advertising is heavily focused on downlink speeds, and there is a widely held view that U.S. operator executives are fixated on how to win bragging rights in the 5G speed race for marketing reasons. Even if coverage is limited, 1 Gbit/s mobile advertising is coming soon to a billboard near you.

Another reason might be related to the three-year timeframe in the question. Given that U.S. operators expect to launch earlier than RoW, the three-year limit will be reached sooner (around 2021-2022), at a point where it is less likely that advanced new use cases will have emerged and matured. Another very plausible reason – perhaps the most plausible, in fact –

is that the U.S. leads in mmWave, a technology that will deliver the highest possible speeds where it is deployed. A 400 MHz or 800 MHz mmWave channel will produce higher peak-rate performance than 100 MHz of C-Band spectrum (the best available elsewhere) and could make 1 Gbit/s downlink a commonplace reality. To go full circle on the marketing point – operators that have it, will flaunt it!

Figure 3: In the first three years of commercial service, what will be the most important commercial benefit of 5G?



Source: Heavy Reading 5G Survey (n=79)

The top RoW response is the 41% that identify "new services and ecosystem expansion" as the primary commercial benefit of 5G three years after service launch. It is fair to say that this reflects the public statements of operator and vendor executives in these regions – especially in Europe, where the search for new customers and new business models is almost a mantra of the 5G investment strategy. Our view is that the emergence of major new markets at scale within three years is probably optimistic, given that these services are dependent on progress in adjacent industries. While U.S. operators seem to have accepted this and adapted to it, the RoW has a vision that perhaps won't materialize until later in the cycle.

We do, however, believe that signs of new service types and business models will be seen around this period, even if at a small scale, creating conditions for rapid expansion in adjacent industries in the following years. Therefore, response to this question may also reflect different cultural attitudes in different regions, when in practice the medium-term objectives are similar worldwide.

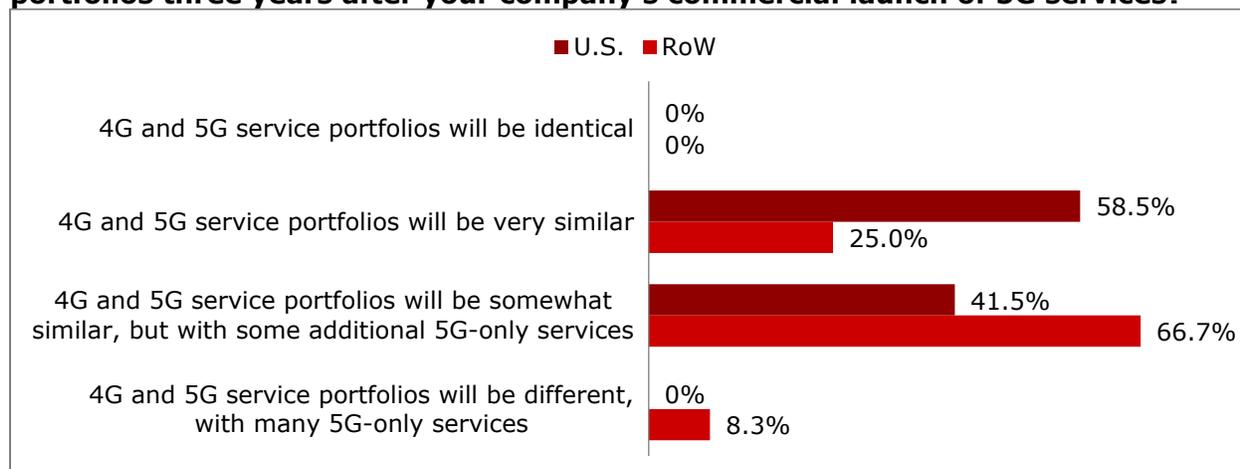
A Unique 5G Service Portfolio?

The next question investigates the idea of 5G-specific services. The overall response clearly clusters around "very similar" and "somewhat similar" views of the future 4G/5G service portfolio. This implies that near-term 5G will be an extension of the current 4G service portfolio. Again, note the three-year timeframe in the question.

As with the prior question, there is a difference between U.S. and RoW, with a majority of U.S. respondents (59%) expecting their company's 4G and 5G service portfolio to be very similar, compared to just 25% of RoW respondents. By contrast, a strong majority of RoW respondents (67%) say that although the portfolio will be similar, there will nevertheless

be "some 5G-only" services. This is consistent with the view that RoW operators are more focused on new services as a rationale for 5G network investment. However, given that responses from both groups are clustered around the middle of the range of options, this is probably more of a nuanced difference than a great divide between global regions.

Figure 4: How much commonality do you expect between your 4G and 5G service portfolios three years after your company's commercial launch of 5G services?



Source: Heavy Reading 5G Survey (n=77)

INDUSTRY VERTICALS & NETWORK SLICING

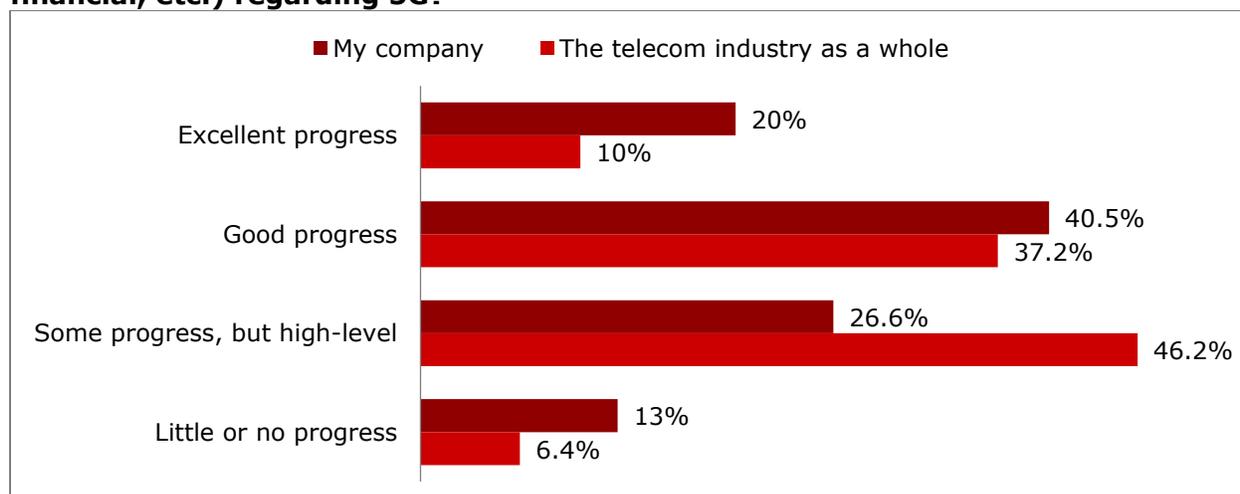
In the study phase, before the start of standardization work, the idea that 5G would introduce new capabilities that would enable operators to extend to new use cases in adjacent industries was well-established. The idea that 5G could become part of the operational processes of virtually every industry and company worldwide is what generated the early hype in 5G, drove investment in R&D and encouraged regulators to allocate spectrum. This vision remains, in our view, appealing and worth pursuing aggressively.

Progress on Industry Verticals

Working with adjacent industries to understand their requirements and incorporate them into specifications, product development and network deployment is important to extending 5G to these new use cases. For demanding applications, such as robotic motion control in factory automation or advanced connected car services, technical requirements must be identified and addressed during specification of the Layer 1 and Layer 2 5G radio design, for example. In other cases, the mobile industry must work at a commercial level to understand the needs of future customers. To use 5G as part of a smart city project or remote healthcare service, for example, requires close collaboration with the respective industries and stakeholders to be viable.

Figure 5 shows how much progress operator respondents think the industry as whole, and their own companies specifically, are making in terms of engaging with industry verticals. The overall picture is "acceptably good, but nowhere near 'great.'" The industry-as-a-whole response shows 46% believe there is "some progress, but high level." A further 6% see "little or no progress," indicating that a slim majority (52%) lean toward somewhat dissatisfied.

Figure 5: How do you rate the progress that your company and the telecom industry as a whole have made so far in engaging with industry verticals (i.e., healthcare, financial, etc.) regarding 5G?



Source: Heavy Reading 5G Survey (n=79)

It is also true that a large number of respondents appear reasonably satisfied. A combined 47% believe the industry as a whole is making either "good progress" (37%) or "excellent progress" (10%). Interestingly, respondents generally believe that their company is doing better than the industry at large. This is most notable among the 20% who say their company is making "excellent progress," which perhaps reflects the demographic of the survey base (which includes large, advanced operators), or perhaps the fact that operator employees are more exposed to initiatives within their own companies than in the broader industry.

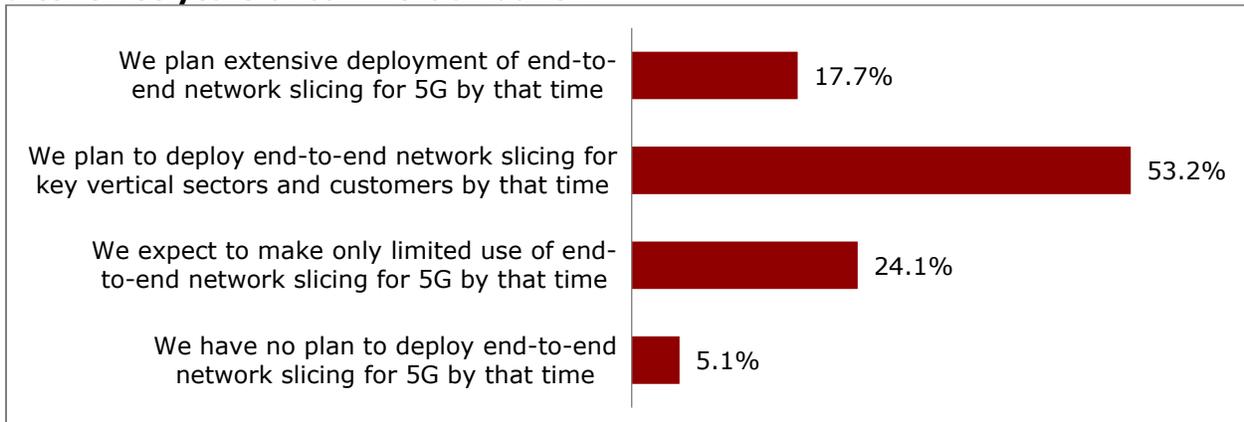
Our firm view at Heavy Reading is that outreach and collaboration with adjacent industries – the future customers of 5G – needs ongoing work, on a committed, sustained basis. The 5G Alliance for Connected Industries and Automation (5G-ACIA) and the 5G Automotive Association (5GAA) are good examples of this type of collaboration. Further, this is not only an operator issue. Large vendors, already very active, continue to have major roles to play in developing global standards and processes for 5G in industry.

Network Slicing

Network slicing is a defining characteristic of 5G. It refers to the ability to support multiple virtual networks, each configured according to the performance requirement of the application in question on a common physical infrastructure. Examples might be a slice configured for a utility, a healthcare provider, a logistics company, etc. In the example of a connected car, multiple slices may be needed per vehicle: ultra-reliable low latency for assisted driving, broadband for infotainment and machine-type communications for telemetry. Network slicing is what will allow operators and vendors to insert 5G into the value chain of myriad business processes. It encapsulates the vision for 5G.

Attitudes toward network slicing are shown in **Figure 6**. Overall, sentiment is positive. Within three years of commercial launch, a majority (53%) of respondents say their company plans to deploy end-to-end slicing for "key vertical customers," and a further 18% plan an "extensive deployment of end-to-end network slicing" by that point. A not-inconsequential 24% expect to make only "limited use" of slicing.

Figure 6: How does your company plan to deploy end-to-end network slicing for 5G after three years of commercial launch?



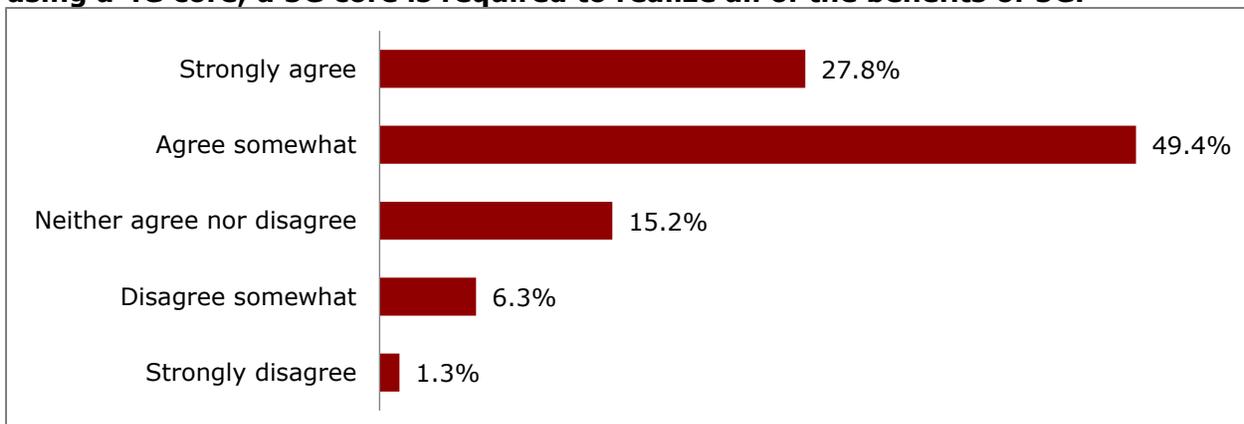
Source: Heavy Reading 5G Survey (n=79)

An End-to-End Capability

One of the challenges for network slicing is that it should apply end to end, and ideally from CPU core to CPU core for the most demanding applications. In practice, this is hard to achieve because the slice must span multiple domains – for example, from user equipment to RAN, transport, core and the cloud. This is an immensely complex, multi-phase, multi-industry task.

One of the critical enablers of end-to-end slicing is the 5G core network, which authenticates subscribers and user equipment, manages session and quality of service (QoS), and applies policies. It also controls the setup and management of network slices from the user equipment (e.g., handset or Internet of Things module) through the RAN into the core and onward to external networks. The survey asked respondents if they believe a 5G core is required to offer the full range of 5G services, which *de facto* includes network slicing. **Figure 7** shows that a majority agree with the statement, either "somewhat" (49%) or "strongly" (28%), that a 5G core is required to realize all of the benefits of 5G.

Figure 7: Please indicate your level of agreement or disagreement with the following statement: It will be difficult to offer the full range of 5G services in NSA mode using a 4G core; a 5G core is required to realize all of the benefits of 5G.



Source: Heavy Reading 5G Survey (n=79)

The fact that the largest respondent group (49%) only "agree somewhat" introduces nuance to the discussion. This is an important voice to pay attention to, because it implies that operators may believe that aspects of future 5G services (whatever they may be) can be supported in 5G RAN connected to 4G core.

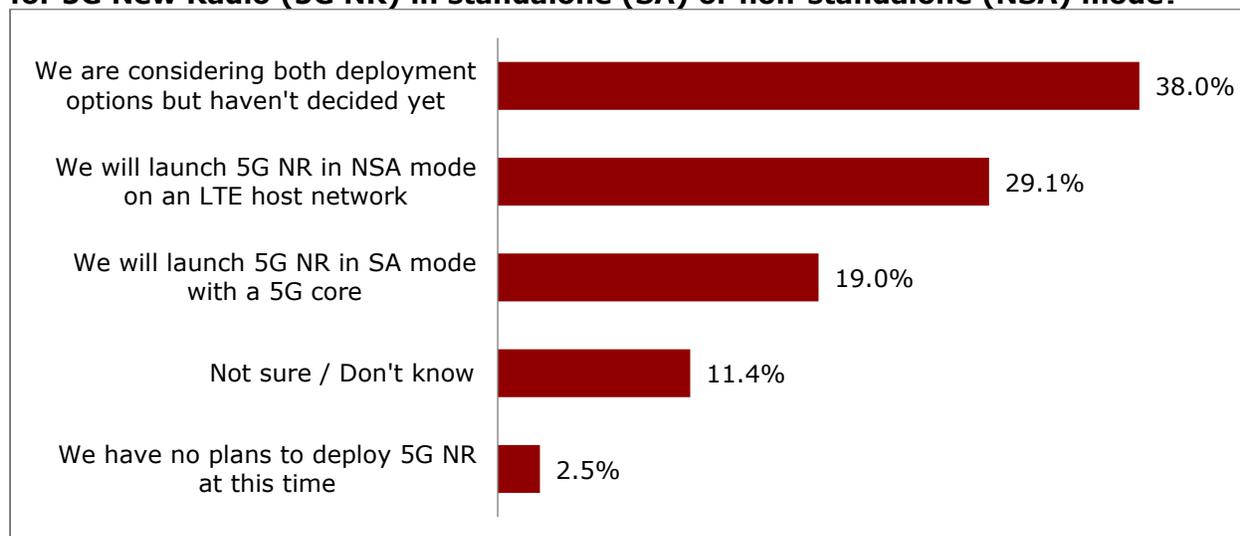
5G CORE NETWORK

There are two basic modes where 5G RAN can be deployed. The first is on a host LTE network using a 4G core and an LTE control plane over the air. This configuration is called non-standalone (NSA) and is expected to be widely used in the early phases. In standalone (SA) mode, an operator can deploy a 5G RAN connected to a 5G core without dependency on LTE, which offers the promise of greater feature capability.

Standalone or Non-Standalone 5G

Many observers, including Heavy Reading, expect that most operators with plans to launch 5G in the next two years or so will do so using a 4G core in NSA mode. This is faster, simpler and, in most cases, a better near-term option for mobility while 5G coverage remains patchy. The respondent base, however, is not so certain: A solid 29% do expect to launch using NSA, but **Figure 8** also shows that this issue is fraught with uncertainty: More than one third of respondents (38%) are "undecided and considering both options," and a further 11% outright say they "don't know." Although it differs from our expectations, this is a reasonable view, in that the outlook *is* uncertain, and has been since before the survey was conducted.

Figure 8: Which of the following best describes your company's deployment plan for 5G New Radio (5G NR) in standalone (SA) or non-standalone (NSA) mode?



Source: Heavy Reading 5G Survey (n=79)

The 19% that expect to launch in SA mode seems to Heavy Reading to be somewhat high, given the maturity of SA and 5G core. However, it is not unreasonable, especially for slightly later deployments. Moreover, if we select responses from the 53 operator respondents with revenue above \$500 million, this figure drops from 19% to 9%, perhaps indicating that greenfield and smaller operators are skewing the outcome toward SA.

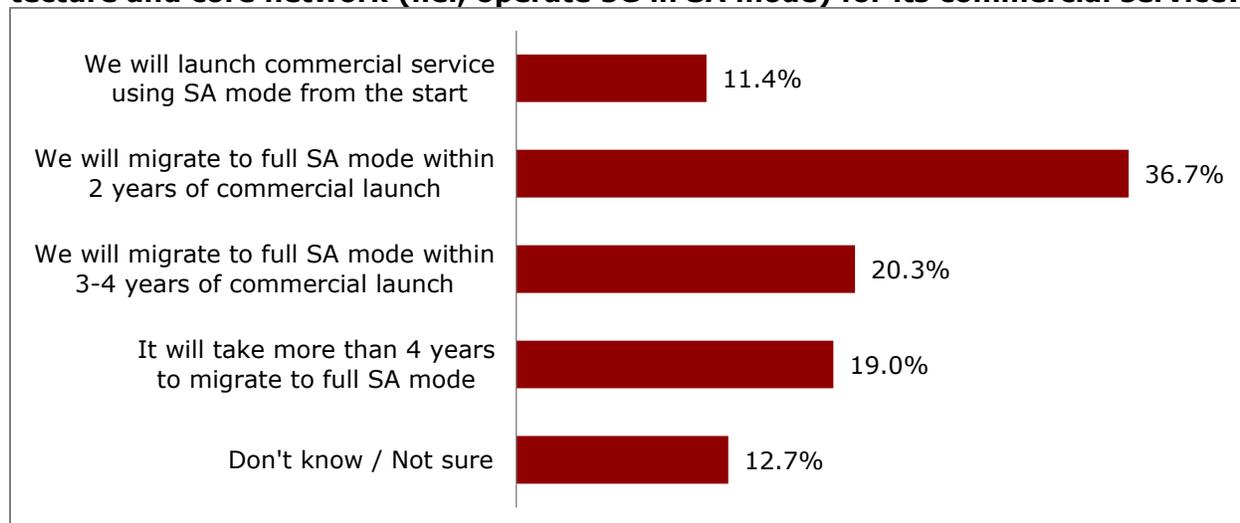
Another factor that complicates this question is that we are aware of several operators that are considering operating 5G using NSA and SA configuration in tandem. They are not mutually exclusive options. For example, SA may be used for a 5G-only network deployed in a specific area or venue network (e.g., a factory floor or warehouse) while NSA is used where dual-mode devices are needed. There are also several scenarios that might see NSA and SA operating in the same macro network, depending on factors such as spectrum strategy, coverage and mobility. This underlines the strong link between core network and RAN strategy and the need to think in terms of a 5G system architecture.

A 5G System Architecture

On the assumption – partly correct, partly erroneous, as it turned out – that some operators will launch 5G using NSA on a host LTE network, we asked respondents when they expect to migrate to a full 5G system architecture using a 5G core. This is useful to know because it is at this point that advanced services, such as end-to-end network slicing and ultra-reliable low-latency communication (URLLC), can be introduced. **Figure 9** shows that operators have quite a range of views on this topic, which again reflects the uncertainty around this question.

The largest respondent group is the 37% that say they expect to migrate to SA within two years of commercial launch – this is an ambitious target, but plausible, especially if this is extended to mean an operator using SA and NSA in tandem. Similarly, 39% – when the "three to four years" (20%) and "more than four years" (19%) options are combined – think it will take longer to migrate to the full 5G system architecture.

Figure 9: When do you expect your company to migrate to a full 5G system architecture and core network (i.e., operate 5G in SA mode) for its commercial service?



Source: Heavy Reading 5G Survey (n=79)

The overall picture, therefore, is one of significant uncertainty about the outlook for the deployment of the full 5G system architecture. It is notable that 3GPP specifications for the migration from NSA to SA were not finalized at the time the survey was fielded, and that they remain uncertain at the time of writing. It may be January 2019 before that is resolved. In the meantime, some operator respondents are bullish, some less so. Both positions make sense and are not necessarily contradictory. Moreover, large operators will typically have multiple programs underway simultaneously.