SPECIAL REPORT

How 5G will transform business

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5G: A transformation in progress

BY CHARLES MCLELLAN

Analogue mobile phones first appeared in the early 1980s, and were used for voice calls only (imagine that!). Second-generation (2G) digital mobiles made their debut a decade later with GSM, offering text messaging (SMS) as the ‘killer application’ on top of voice services, becoming the dominant technology worldwide. A roughly 10-year cycle has continued ever since, with each generation adding more data bandwidth and therefore enabling a richer set of services: around the turn of the millennium, 3G (UMTS or CDMA 2000) offered data rates of around 1Mbps and could be described as ‘mobile broadband’, while 2010 saw 4G (LTE) reaching 100Mbps.

Of course, as in any evolutionary process, there have been intermediate stages: GPRS and EDGE were ‘2.5G’ packet-switching technologies that made internet connections possible, for example, while HSPA and HSPA+ brought ‘3.5G’ data rates up to 2Mbps. More recently, ‘4.5G’ LTE-Advanced and LTE Advanced Pro have paved the way from 4G to 5G, taking data rates up to 1Gbps.

We are now on the cusp of the 5G era, with standards, spectrum allocation, network infrastructure, chipsets and devices all moving into place around the world. Fast 5G networks with low latencies and high connection densities will improve existing mobile experiences and, in due course, enable new use cases.

In the meantime, as the 5G ecosystem develops, we will inevitably see a lot of marketing activity—some of it distinctly questionable.

This article sets the post-CES 2019 5G scene: for more detail, see the remaining content in this ZDNet special feature.
5G SPECS AND USE CASES

The road to 5G began back in 2015, with the ITU’s IMT-2020 framework, which set out the general requirements and future development of the next-generation mobile technology (IMT stands for International Mobile Telecommunications). Here’s how the performance requirements (which were approved in November 2017) compare to the previous-generation IMT-Advanced (a.k.a. 4G):

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<th>4G (IMT-Advanced)</th>
<th>5G (IMT-2020)</th>
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<tr>
<td>Peak data rate (downlink)</td>
<td>1Gbps</td>
<td>20Gbps</td>
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<tr>
<td>User-experienced data rate</td>
<td>10Mbps</td>
<td>100Mbps</td>
</tr>
<tr>
<td>Latency</td>
<td>10ms</td>
<td>1ms</td>
</tr>
<tr>
<td>Mobility</td>
<td>350km/h</td>
<td>500km/h</td>
</tr>
<tr>
<td>Connection density</td>
<td>100,000 devices/sq km</td>
<td>1,000,000 devices/sq km</td>
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<tr>
<td>Energy efficiency</td>
<td>1x</td>
<td>100x</td>
</tr>
<tr>
<td>Spectrum efficiency</td>
<td>1x</td>
<td>3x</td>
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<tr>
<td>Area traffic capacity</td>
<td>0.1Mbps/sq m</td>
<td>10Mbps/sq m</td>
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The ITU’s broad goal for IMT-2020/5G was to accommodate “new demands, such as more traffic volume, many more devices with diverse service requirements, better quality of user experience (QoE) and better affordability by further reducing costs”. The key driver for this effort was the need to “support emerging new use cases, including applications requiring very high data rate communications, a large number of connected devices, and ultra-low latency and high reliability applications”.

THE MT-2020 VISION FOR BROAD CLASSES OF 5G USE CASES (IMAGE: ITU IMT-2020)
It’s clear from these scenarios that 5G will be as much about businesses as it is about consumers. Yes, there’s Ultra-HD and 3D video, augmented reality, smart homes, self-driving cars and more. But there’s also a multitude of business opportunities to be exploited in 5G-enabled smart offices, cities, factories and farms.

These mobile use cases are enabled by three classes of service: eMBB (enhanced Mobile Broadband); URLLC (Ultra Reliable Low Latency Communications); and mMTC (massive Machine Type Communications).

eMBB essentially delivers faster and better mobile connectivity—not only for consumer smartphone users, but also for mobile professionals with 5G-enabled tablets or laptops, or field workers using AR apps and smart glasses, for example. Now enshrined in the June 2018 3GPP Rel 15 standard, which includes NSA (non-standalone, built on LTE-A/Pro) and SA (standalone) elements, eMBB is the first phase of 5G. The second phase will address the kinds of connections required by self-driving vehicles (reliable, low-latency—URLLC) and IoT device-heavy environments like smart cities (moderate bandwidth, high density—mMTC), and will be covered by the developing 3GPP Rel 16 standard, which was originally due for completion in December 2019 (see below) but has now been put back by three months.

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**3GPP Ongoing Releases**

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<th>2017</th>
<th>2018</th>
<th>2019</th>
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<tr>
<td>TSG# 76</td>
<td>TSG# 79</td>
<td>TSG# 83</td>
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<td>78</td>
<td>82</td>
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**Release 14**

- Rel.14 St.3 Extension

**Release 15 (5G Phase 1)**

- Rel.15 Stage 1
- Rel.15 Stage 2
- Rel.15 Stage 3
- Freezing Non-Standalone (NSA)
- Rel.15 ASN.1

**Release 16 (5G Phase 2)**

- Rel.16 Stage 1
- Rel.16 Stage 2
- Rel.16 Stage 3
- Rel.16 ASN.1 (TSG#87)

*Image: 3GPP*
Another 5G use case is FWA (Fixed Wireless Access), which enters the picture because data rates will be sufficient to compete with wired broadband (over copper or optical fibre—even fibre-to-the-premises). According to recent research from Ovum (sponsored by UK mobile operator Three), 5G is expected to deliver data rates of 80-100Mbps in the UK and could replace traditional wired broadband connections for 85 percent of the country’s 26 million fixed-line customers:

Other advantages of FWA, says Ovum, include plug-and-play setup, flexible contracts and portability—customers simply take the wireless home broadband box with them when they move. (Note: Three has a stake in this market via its UK Broadband-operated subsidiary Relish, which currently offers FWA on its 4G LTE network).

THE STATE OF PLAY: EARLY 2019

Next-generation 5G networks will operate on three broad radio frequency bands, each of which have different characteristics and address different use cases. Low frequency (sub-1GHz) spectrum is well suited to wide-area and indoor coverage, and will be important for improving mobile coverage in underserved rural areas as well as mMTC and URLLC applications. Mid-frequency (1-6GHz) spectrum supports a good combination of capacity and coverage, and is the initial focus for eMBB and FWA, with mMTC to and URLLC to follow. High-frequency spectrum—a.k.a. millimetre wave, or mmWave (>24GHz)—supports very high speeds and low latency within local ‘hot-spot’ areas and can deliver ‘full’ eMBB and high-speed FWA, although indoor coverage is poor.
The precise bands used will vary around the world, but here’s the picture in the UK (as of March 2018—the 2.3GHz and 3.4-3.6GHz auctions referenced below are now complete):

Following its May 2017 acquisition of UK Broadband (UKB), Three currently holds the most 5G spectrum among the UK’s four mobile network operators, although there are upcoming 700MHz and 3.6-3.8GHz auctions in 2019 (which Ofcom aims to conclude by spring 2020):
In its March 2018 *Enabling 5G in the UK* report, Ofcom noted that high-frequency mmWave spectrum has not been used to deliver mobile services to date, but is likely to support new high-capacity, low-latency 5G applications. The UK regulator has called for input from MNOs and other players on the 26GHz (24.25-27.5 GHz) band, and has also prioritised 66-71GHz as a second stage high-frequency band, with 40.5-43.5GHz targeted as a priority band for study.

All four UK network operators are now trialling 5G services: EE in London; O2 at London’s O2 Arena; Vodafone in Salford, Greater Manchester (with six more cities to follow); and Three in London. Areas of high demand—i.e. big cities—may get limited 5G services (FWA and eMBB) in 2019, but it will take years before 5G coverage is widespread and new (URLLC and mMTC) use cases are fully supported.

Looking further afield, in November 2018 the GSA (Global mobile Suppliers Association) estimated that 192 operators in 81 countries were actively investing in 5G—that is, “have demonstrated, are testing or trialling, or have been licensed to conduct field trials of 5G technologies, are deploying 5G networks or have announced service launches”.

The GSA identified over 524 demonstrations or tests, noting that:

“Key 5G technologies being explored include new radio (NR) interfaces operating in spectrum bands not previously used for mobile telecoms services and network slicing to support delivery of services tailored to specific types of customer or service; combinations of technologies such as massive MIMO, or complex beam-forming that are needed to achieve very high speeds; and backhaul, cloud- and edge-computing arrangements to support very low latencies.”

At least 87 of the 524 projects tested massive MIMO involving 64 or more transmitters or some other 5G-specific technology, while 26 explicitly featured network slicing, the GSA reported. The most common frequency band in the tests was 3.3-3.8GHz (107 trials), followed by 26.5-29.5GHz (87 trials). Many of the trials reported peak downlink speeds of well over 1Gbps, although the GSA noted that the very highest speeds will not be deliverable by commercial networks for some time.
As far as latencies are concerned, most of the 68 trials examined by the GSA achieved 1-1.99ms, although again these test results may not be representative of production networks:

![Graph showing latency distribution](image)

At the time of the GSA’s report (November 2018), Verizon was leading the way on live 5G coverage, with FWA services available in four US cities. Since then, AT&T has turned on its mobile 5G network in 12 US cities, with a further seven to come early in 2019. “Small/limited scale launches have been announced by Elisa in Finland and Estonia (mobile and FWA), Etisalat in the UAE (FWA), TIM and Fastweb in Italy and Vodacom Lesotho (FWA),” said the GSA, adding that a number of other operators have turned on commercial 5G base stations but await devices or long-term licences.

“In total, 80 telecom operators in 46 countries have announced intentions of making 5G available to their customers between 2018 and 2022. 2020 is likely to be an important year for 5G launches, with at least 37 networks currently scheduled to go live that year,” the GSA report concluded.
5G at CES 2019

5G has been a key topic at CES in recent years, and the recent 2019 show predictably saw plenty of activity. Here’s a summary of ZDNet’s 5G coverage at CES 2019:

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<th>CES 2019 news (ZDNet)</th>
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<tr>
<td>Qualcomm President Amon is convinced you’re going to be thrilled with 5G</td>
<td>Qualcomm’s president, Cristiano Amon, took some time at the Consumer Electronics Show to discuss how 5G cellular will amaze consumers. He also reflected on how AI processing on smartphones will become more prevalent.</td>
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<tr>
<td>Sprint rounds out CES 2019 with 5G call</td>
<td>Working with Nokia and Qualcomm, Sprint has made a 5G data call on its live commercial network in San Diego, including streaming YouTube videos, making Skype video calls, and sending and receiving messages.</td>
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<td>CES 2019: Intel details autonomous vehicle trial in Israel</td>
<td>Intel is extending its autonomous driving trials in Israel to provide an entire mobility-as-a-service offering across car, software, platform, mapping, and safety mechanisms.</td>
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<tr>
<td>CES 2019: Telstra CEO Andy Penn talks 5G smartphones</td>
<td>Speaking with ZDNet at CES 2019 in Las Vegas, Telstra CEO Andy Penn discussed 5G devices, possible pricing, download speeds, and what 5G will mean for IoT.</td>
</tr>
<tr>
<td>CES 2019: Las Vegas and Los Angeles see 5G as a game changer for smart cities</td>
<td>AT&amp;T is working with Los Angeles and Las Vegas on multiple smart cities projects, with the two cities saying 5G will bring even more opportunities.</td>
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<tr>
<td>CES 2019: Telstra confirms 5G smartphones by mid-2019</td>
<td>Telstra has announced multiple agreements to offer commercial 5G smartphones to customers in the first half of 2019.</td>
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<td>CES 2019 news (ZDNet)</td>
<td>Summary</td>
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<td>CES 2019: First look at the Samsung 5G smartphone</td>
<td>Samsung is showing off its 5G smartphone prototype at CES 2019, giving users a first taste of what the device will look like.</td>
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<tr>
<td>CES 2019: Verizon showcases the potential of 5G with drones, Disney and more</td>
<td>5G connectivity will be “a quantum leap compared to 4G,” Verizon CEO Hans Vestberg said during his CES keynote.</td>
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<tr>
<td>CES 2019: Sprint pairs Curiosity IoT with 5G to power smart cities, autonomous vehicles</td>
<td>Sprint is combining its Curiosity IoT platform and its 5G mobile network to power a smart city in South Carolina and an autonomous vehicle test track in Georgia, and to launch more precise mapping technology.</td>
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<td>CES 2019: AT&amp;T 5G to connect hospitals and stadiums</td>
<td>AT&amp;T is working on hospital and stadium use cases for its newly launched 5G network, as well as announcing that it will be connecting Toyota and Lexus cars with LTE between 2019 and 2024.</td>
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<td>CES 2019: Intel’s Mobileye signs deal with UK mapping agency</td>
<td>Mobileye and Ordnance Survey have announced that they will collect and share map data for better management of infrastructure aimed at enabling smarter cities.</td>
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<tr>
<td>CES 2019: Sprint unveils smart home Magic Box, confirms Samsung 5G phone</td>
<td>Sprint has used CES 2019 to unveil a small cell smart home product with LTE and Alexa integration, as well as confirming a Samsung 5G smartphone launching in the summer.</td>
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**CES 2019 news (ZDNet)**

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<tr>
<td><strong>T-Mobile marks 5G milestone with first data call on 600 MHz spectrum</strong></td>
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<td>The carrier said it has completed a series of successful 5G service tests in the 600MHz band with partners Intel and Ericsson.</td>
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<td><strong>CES 2019: Ford demos cellular V2X with Qualcomm chipset</strong></td>
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<td>Ford is using CES 2019 to demo how its Qualcomm-powered cellular V2X technology enables multiple cars to negotiate rights of way at four-way intersections without traffic lights and stop signs.</td>
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Samsung’s **prototype 5G phone** received a lot of attention, even though it simply sat in a perspex box on the booth wall, running a video (from internal memory) about the company’s 5G goals. It has a conventional form factor, but no technical details were revealed about its internals. However, the US network **Sprint** revealed at CES that it will be carrying Samsung’s 5G smartphone later this year on its LTE and 5G networks using the 2.5GHz, 1.9GHz, and 800MHz spectrum bands.

**Coming soon: Mobile World Congress**

Naturally, 5G is a major theme at the other big tech show at the start of the year—**Mobile World Congress** (MWC) in Barcelona (25-28 February). Among the unveilings expected is a **5G phone from OnePlus** using Qualcomm’s new **Snapdragon 855 chipset** and **X50 5G modem**. This is expected to launch in the spring on the UK EE network (using sub-6GHz spectrum), before becoming available from other carriers worldwide. **LG** has also flagged up an MWC 5G handset announcement based on the Snapdragon 855 chipset.

**WHAT THE SURVEYS SAY**

There have been plenty of surveys of different parts of the 5G ecosystem, by various interested parties. Here’s a selection from the past six months or so.

**IHS Markit**

Business information provider **IHS Markit** polled 17 mobile operators for its August 2018 **Evolution from 4G to 5G: Service Provider Survey**. The headline finding was that 14 (82%) were trialling and testing 5G...
technology, while two (12%) -- both from North America—were planning commercial rollouts by the end of 2018. South Korea is expected go live with 5G in 2019, said IHS Markit executive research director Stéphane Téral in a statement, while most European networks were not planning to deploy 5G until 2021 or later.

Ultra-low latency was the main 5G technical driver for 82 percent of the mobile operators, followed by decreased cost per bit (76%) and increased network capacity (71%). When it came to challenges, 53 percent cited radio as requiring the biggest development effort to make 5G happen, followed by transport (24%) and management (14%).

The highest-rated 5G use case was eMBB, although FWA was expected to be ready for commercial development first. “The bottom line is early 5G will be an extension of what we know best: broadband, whether in FWA or eMBB form,” Téral said. “Don’t expect factory automation, tactile low-latency touch and steer, or autonomous driving to be ready on 5G anytime soon despite being touted as the chief 5G use cases,” he added.

Gartner
In May-June 2018, Gartner investigated the demand and adoption plans for 5G among 185 survey respondents (85 Research Circle members and 100 others). IoT communications was the most popular 5G use case (59% of respondents), followed by video (53%). However, echoing IHS Markit’s findings, Gartner senior research
director Sylvain Fabre warned in a statement that 5G networks were far from ready for all use cases: “In the short to medium term, organizations wanting to leverage 5G for use cases such as IoT communications, video, control and automation, fixed wireless access and high-performance edge analytics cannot fully rely on 5G public infrastructure for delivery.”

Gartner noted that a new network topology is required to fully exploit 5G, including new network elements such as edge computing, core network slicing and radio network densification. This will take time: “Most CSPs [Communications Service Providers] will only achieve a complete end-to-end 5G infrastructure on their public networks during the 2025-to-2030 time frame—as they focus on 5G radio first, then core slicing and edge computing,” Fabre said.

As a result, organizations keen to deploy 5G quickly may need to look beyond CSPs. “Private networks for enterprises will be the most direct option for businesses that want to benefit from 5G capabilities early on,” said Fabre. “These networks may be offered not only by CSPs but also directly by infrastructure vendors—and not just by the traditional large vendors of infrastructure, but also by suppliers with cloud and software backgrounds.”

**Deloitte**

In a June 2018 survey of nearly 4,000 UK smartphone users (The Race to 5G), Deloitte found that just 12 percent of respondents would switch to a 5G network as soon as it became available. A further 19 percent would switch on hearing positive reports, while 32 percent would ‘probably switch to a 5G network eventually’. Hardly evidence of pent-up demand, although the release of the first 5G handsets during 2019 is likely to change this picture fairly quickly.
PwC

In September 2018, PwC surveyed a sample of 1,000 Americans aged 18-64 to investigate several things: their satisfaction with current home and mobile internet services; how they feel about 5G’s potential; what they expect from 5G (in the home and on mobile devices); and their willingness to pay for 5G.

Only 46 percent of respondents were familiar with the term ‘5G’ without prompting (57% male, 37% female), although 62 percent found it ‘very appealing’ once defined. The main ‘must-have’ across both home and mobile internet was reliability (33% home, 32% mobile), with portability (66%), DIY installation (57%) and wireless (39%) adding to the appeal of 5G FWA in the home. On average, consumers would be willing to pay $5.06 extra/month for 5G home internet and another $4.40/month for 5G mobile internet. The main driver for this willingness to pay more was faster data speeds, both for home (49%) and mobile (63%) internet.

Given that 5G handsets are not yet available, it’s perhaps no surprise that PwC’s respondents weren’t exactly clamouring for the new technology: 74 percent would wait until they were eligible for an upgrade, while only 26 percent were prepared to buy a new device regardless. Having said that, there was some willingness to change mobile habits for 5G: 32 percent would switch providers; 21 percent would switch mobile device brands; and 19 percent would switch platform or OS.

AN ‘END-TO-END’ APPROACH TO 5G

You can’t go far in 5G-land without encountering the term ‘end to end’ (or E2E) with reference to network architecture. That’s because there’s a lot more involved in being a network operator than winning RF spectrum and building a radio-access network (RAN): other key components are backhaul (or transport) from the base stations to the core network, plus supporting IT operations. A full 5G deployment requires architecture changes at every stage:

![End-to-end delivery is critical](image:three_uk)
For example, as well as acquiring a healthy 5G spectrum portfolio, UK mobile operator Three has:

- Signed an agreement for the rollout of new cell site technology to prepare major urban areas for the rollout of 5G devices, as well as enhance the 4G service
- Built a super high-capacity dark fibre network, which connects 20 new, energy efficient and highly secure data centres
- Deployed a world-first 5G-ready, fully integrated cloud-native core network in new data centres, which at launch will have an initial capacity of 1.2TB/s, a three-fold increase from today’s capacity, and which can scale further, cost effectively and rapidly
- Rolled out carrier-aggregation technology on 2,500 sites in the busiest areas, improving speeds for customers

Investments of this order—Three has committed to spend £2 billion—underscore the fact that different 5G use cases (eMBB, URLLC, mMTC and FWA) have different requirements when it comes to bandwidth, latency, mobility, security, reliability and pricing. Early 5G deployments are concentrating on traditional more consumer-oriented areas such as eMBB and FWA, are based on the finalised 3GPP Rel-15 standard, and can utilise a lot of existing 4G LTE infrastructure. But phase 2 of 5G will be based on the still-developing Rel-16 standard, and will require new spectrum and infrastructure to support advanced business use cases like URLLC and mMTC.

Enabling all this requires a cloud-native, service-oriented architecture that supports network slicing, where multiple virtual networks coexist on the same physical infrastructure, leveraging technologies like software-defined networking (SDN) and network function virtualisation (NFV).
In a May 2018 white paper, Ericsson described a trial with Swisscom showing how network slicing supports critical railway communications on a public network carrying mobile broadband traffic. High-definition video—from cameras on platforms and in the front of trains—was isolated, with guaranteed performance levels. “Assurances are required when trains are in areas with only moderate radio signal coverage, or during periods of particularly high mobile broadband traffic loading,” Ericsson said. “Although capacity demands from critical communications are low, RAN radio resource partitioning can be used to maximize available capacity for other lower-priority demands, without affecting performance guarantees.”

Although it’s crucial to full 5G deployment, network slicing is still very much a work in progress: in the November 2018 GSA report described earlier, just 26 out of 524 5G demos or tests (5%) explicitly featured the technology. There’s plenty at stake though: according to the GSMA, network slicing will permit operators to address revenue opportunities worth $300 billion by 2025. “To unlock this opportunity, Network Slicing will enable operators to create pre-defined, differing levels of services to different enterprise verticals, enabling them to customise their own operations,” the GSMA said. “However, the opportunity could become even bigger. Automation and the ability to quickly create slices could pave the way for operators to dynamically package and repackage network capabilities for different customers. This is the end goal of Network Slicing.”

OUTLOOK

Network operators are implementing the first phase of 5G, and 5G smartphones are beginning to surface, all of which means that general awareness of 5G is increasing. However, there’s still a lot of end-to-end work to be done before fully operational 5G networks can support the advanced use cases that could transform business.
Survey: Professionals eager to deploy 5G

BY MELANIE WACHSMAN

5G technology holds promises of enabling never-used-before technology, improving worker productivity and customer service, cutting costs, and more. Does 5G remain a pipe dream for businesses or an actual reality? Throughout December 2018 and January 2019, ZDNet’s sister site Tech Pro Research surveyed 164 professionals to find out.

The results demonstrate the enterprise’s enthusiasm for this new technology. The majority of respondents (85%) are, in fact, already using 5G technology or have plans to adopt it sometime in the future. Survey respondents list introducing new technology such as analytics and IoT (54%), faster mobile transfers for more productivity (50%), and the potential for reduced data spending (27%) as reasons why their companies will use 5G.

Additional reasons for introducing 5G run the gamut from faster mobile transfers to the enjoyment of being on the “cutting edge” of technology. Thanks to 5G, more than 56% of survey respondents will enable new technology that they could not use before. Better connections for IoT applications, improving content delivery and controlling remote devices top the list of upcoming plans for 5G. Nearly half of respondents (47%) expect to deliver better customer service, while 37% of respondents believe 5G will increase employee productivity on the road. A smaller number of respondents (18%) expect 5G to reduce data plan spending or other costs related to communications.
ROADBLOCKS: WHAT MAY HINDER 5G ADOPTION?

Enthusiasm for 5G does not necessarily translate to 5G deployment for all respondents. A slim margin of survey takers (10%) are not preparing or planning to adopt this new technology. According to those respondents, 36% are taking a “wait and see” approach regarding 5G implementation, and 28% remain satisfied with 4G and see no reason to upgrade.

Further, many respondents share concerns about 5G availability. More than half (61%) said that the simple lack of 5G service to their area may hinder adoption. Another apprehension about 5G is that 67% of respondents don’t believe their existing infrastructure can handle the technology. This makes sense since many organizations still rely on on-premise legacy applications.

The above-mentioned roadblocks will not slow down the inevitability of 5G. Most organizations recognize the need to upgrade their infrastructure. More than 57% are looking at ways 5G can improve upon their existing technology. One-third (36%) are setting aside integration concerns and re-platforming legacy applications and cloud-based access. Only, 21% of respondents are not preparing for this new technology at all.

No matter what state of deployment your company is in regarding 5G, it’s here, and it’s ready to transform the enterprise.

This infographic contains more details from the research. For all the findings, download the full report: 5G Research Report 2019: The enterprise is eager to adopt, despite cost concerns and availability (available for Tech Pro Research subscribers).

END USERS TO BLAME

Mobile devices were considered a company’s weakest security link back in 2016. This shifted in 2018, as 44% percent of respondents ranked end users as their company’s weakest security link (only 13% attributed the honor to mobile devices). This is most likely due to the understanding that devices don’t cause security breaches—rather, end users’ actions do—such as unwittingly clicking on suspicious links, opening attachments with malicious payloads, or leaving devices unlocked.

To no surprise, most respondents pointed out the need for improved end-user security training as well as education pertaining to overseas laws (25% of respondents indicated their own ignorance of overseas laws) to improve security.

This infographic contains more details from the research. For all the findings, download the full report 2018 Cyberwar and the future of Cybersecurity Report (available to Tech Pro Research subscribers).
5G New Radio: The technical background

BY RUPERT GOODWINS

Although 5G is being heavily marketed as a new technology, it’s neither particularly new nor a single technology. If mobile technology were a long-running TV series, 5G is a mid-season reboot, with new characters introduced alongside the old, new plot arcs complementing existing storylines, and a publicity drive that rather overstates the case. However, the possibilities for future development are much enhanced.

There have been three major new generations of mobile technology: 2G replaced analogue with digital; 3G began the switch to data-centric networking; and 4G completed that move. 5G has three main focuses—mobile networking, IoT, and very high-performance industrial control—of which mobile networking will be the most important for most people over the next few years, and which is best thought of as a continuation of 4G’s Long Term Evolution (LTE) under a new flag. Indeed, this stage of 5G is known as NSA (Non Stand Alone) as it will run alongside and interoperate with existing LTE networks. SA (Stand Alone) comes later.

Which is not to say that there aren’t significant innovations in 5G. While the 5G standardisation process covers core network and base station topology as well as other aspects of running high-performance networks, most of the factors that will affect our first experiences of 5G are affected by the subset of standards called New Radio, or 5G NR. Although work on NR was only started in the spring of 2016, it quickly rolled up the until-then very disparate research area and has already produced a number of nearly-there pre-standard references (see boxout below).

15, THAT DIFFICULT STAGE...

5G NR is developed by a group called 3GPP, the 3G Partnership Project, and the first version of the standard is called Release 15. 3GPP is so called because it was first formed to standardise 3G; it has considerable authority as an international group that brings together standards committees, regulators and industry bodies, and the legal issues over renaming it were too onerous when 4G came along. Release 15 is the 18th major standard, which fact is an excellent indicator of how organisations at this level actually work.

Release 15 has been produced at some speed. Starting in early 2016, a preliminary release in March 2018 was declared complete enough for manufacturers to start preliminary production. By the third quarter of 2018, both Ericsson and Huawei said they’d deployed more than 10,000 base stations on that release. A further standard update appeared in September, with a ‘feature freeze’ final pre-standard version of Release 15 promised for December. However, chips developed by Qualcomm to the September release were reported by industry site Light Reading to have proved incompatible with the March-release-based base stations, potentially requiring a hardware swap.
As a result the December freeze has been postponed to March 2019 with knock-on delays for Release 16, which is expected to bring the low-latency and high-speed aspects of 5G to prominence. The difficulties, according to 3GPP, were caused by a lack of communication between the technical subgroups working on the Radio Access Network side, those defining the overall system configuration, and those in charge of the core network configuration. Citing overwhelming workloads, the 3GPP said that there had been no time for a coordination meeting of all the subgroups prior to the September release.

The industry is sympathetic, with players like Samsung saying that they’re not changing their roll-out plans. Samsung is expected to show a 28GHz-enabled 5G handset at Mobile World Congress in February 2019.

5G NR includes major advances over LTE, each with specific benefits.

**SPECTRUM**

Most importantly, there’s masses of new airspace. 5G NR includes millimetre-wave (mmWave) spectrum (>24GHz) for the first time, with the first release of 5G including frequencies from below 1GHz up to 52.6GHz. The high-frequency spectrum (> 6GHz) comes in many different bands that vary by region, as well as many that are not yet fully available due to existing services that must be closed or moved.
The high-band allocations can support very high data rates and intensive frequency reuse, providing very dense, high-performance networking. They have very limited range for a given transmission power compared to lower bands and more stringent health and safety limits, and they are more susceptible to environmental issues like heavy rainfall and seasonal leaf growth. Conversely, the very small wavelength makes it much easier to build very high-performance antennas of small physical size.
The high bands will be used to overlay existing LTE networks, providing much higher bandwidth on demand to reduce LTE (and eventually, 5G) mid- and low-band congestion, as well as fibre-speed home and office fixed wireless access (FWA) broadband. The 28GHz bands have seen the most attention, with the UK breakdown by region and operator being typical of how a territory already well-serviced with LTE will allocate resources.

ULTRA-LEAN DESIGN

Ultra-lean design is a key 5G NR design principle, reducing energy consumption and interference. LTE relies on a number of always-on signals transmitted by base stations—beacons that show which cells are available, reference channels that terminals and base stations use to configure data links, command channels for tracking mobility and so on. In LTE, these signals don’t take up a significant percentage of the overall channel usage, but 5G will have a much denser network with more cells, which will on average have quite a low actual usage rate. The always-on signals will thus take a greater percentage of power, and will interfere more with adjacent cells, leading to lower throughput.

Wherever possible 5G reduces or switches off such signals until they’re actually needed. The reference signal, for example, is only transmitted once data transfer is under way. This means the handset and base station have to optimise the signal on the fly, but the overall benefit to throughput for the network is notable.

Ultra-lean design is also a key component of forward compatibility, a specific requirement in 5G NR for curiously unspecific ends. The basic rule is to leave as much room as possible in implementations to allow future developments. In practice, this means minimising non-data carrying transmissions (reducing overall interference and spectrum use), having a high degree of frequency and time-domain flexibility in 5G designs, and providing paths for reconfiguration in the future both in the hardware and in the specification itself.

This latter decision came about through experience with LTE, which encodes a number of design decisions in the specification such as when and where error-correction happens; if a new service finds these decisions inefficient or even disabling, then there’s nothing that can be done. A reconfigurable standard can improve on old decisions. Also, new basic technologies such as software-defined radio (SDR) have moved much radio engineering from hardware into software, meaning that changing operating characteristics in ways that once took a complete hardware revision can now be pushed out as a software update. 5G is the first generation to fully embrace this.

MODULATION AND FRAMING

5G modulation and framing is also an increment from existing ideas, but a significant one. Like LTE (and recent wi-fi standards, and just about every modern digital wireless system), 5G NR uses ODFM as its underlying modulation scheme. ODFM (orthogonal frequency division multiplexing) combines multiple subchannels within a channel, and is known to be both robust against interference and efficient in its use of
frequencies. It’s also highly flexible, as different numbers of subcarriers can be added to increase a channel capacity, or numbers reduced to provide much lower-power, lower-bandwidth options.

5G NR can choose subcarrier spacing from 15kHz to 240kHz, with a maximum 3300 subcarriers in simultaneous use on one channel. However, channels can be no more than 400MHz wide. The standard is frequency agnostic, meaning any subcarrier configuration can be used on any band. In practice, the mid- and low-band frequencies below 6GHz have markedly different channel and noise characteristics, as well as different maximum bandwidths, to the high-band allocations, so will use 15 to 60kHz channel spacing, while high-band will use 60 to 120kHz. There are currently no 5G band allocations between 6GHz and 24.25GHz, but the standard allows for optimal OFDM configuration to match any future expansion into this spectrum.

Not all devices on 5G NR have to support all bandwidths, which is a change from LTE. Furthermore, 5G NR supports adaptive bandwidth, letting devices move to a low-bandwidth, low-power configuration when appropriate, and gearing up to higher bandwidths only when necessary. This creates the opportunity for very low average power devices that can still deliver high performance—IoT networks, for example, which normally only need small amounts of data for telemetry, but nevertheless need to be able to update their firmware for security and feature patches. The 5G NR specification refers to these different configurations as ‘bandwidth parts’, and in theory a device can support multiple bandwidth parts simultaneously on the same channel, although the first 5G NR release limits devices to one bandwidth part at a time.

Within a subchannel, data is divided up into frames of ten milliseconds each, further subdivided into ten 1ms subframes. Those subframes are themselves divided into slots of 14 OFDM symbols apiece. Thus, wider bandwidth subchannels have more OFDM symbols per second and each slot thus gets shorter, but the basic frame structure stays the same. At the lowest subcarrier spacing, 15kHz, the frames are identical to LTE, simplifying compatibility.
LTE and similar systems allocate bandwidth to different devices by slot, but 5G NR has a mechanism for a transmission to start within a slot, effectively creating what are called ‘mini-slots’. This is especially useful for the high bands, which can have very large OFDM symbols and thus the ability to use just a few to carry a relatively short message improves both channel reuse and latency.

Another potential advantage is if, or when, 5G expands to unlicensed spectrum, which normally comes with a ‘listen before use’ rule to prevent interference. If a channel appears quiet, the ability to start a transmission without having to wait for a slot boundary reduces the chance of another device grabbing the channel.

Other low-latency adaptations in 5G NR are tight requirements for data transmissions to start after a channel is granted, and restrictions on processing delay for data streams. This is achieved in the higher network layers by changing header structures so that processing can begin without the full packet information being known, and at the physical layer by having the radio receive essential information from reference and downlink control signals instead of deriving it from the symbol stream.

**BEAMFORMING**

5G NR has a much more advanced concept of **beamforming** than LTE. Beamforming is the manipulation of the signals fed to and received from complex antennas to create beams in space that focus power in a particular direction. LTE could do this for data; 5G NR extends this to control channels too, while increasing the precision and adaptability overall for operation under different conditions.

At the high bands, beamforming will mostly be used to increase range by energy focus, while at the mid and low bands below 6GHz, where attenuation is less of a problem, beamforming will be a key part of **MIMO**, the multiple-in multiple-out spatial channel technique that increases bandwidth for multiple devices in the same area. Although not part of the first release, 5G NR will support distributed-MIMO, where a user can receive different parts of the same data stream from multiple sites.
This touches on the other major areas of 5G beyond the radio: how base stations communicate with each other and with the core network, how the operators manage the whole system for reliability and profit, and what shapes the new network uses built on the back of these technologies will take. Don’t expect the full picture to become clear for three to five years: 5G in 2019 will be as much about groundwork as immediate results.
New 5G business models

BY RUPERT GOODWINS

There is one overriding question when examining the case for new 5G business models: is there an elephant in the room? It’s the old fable of three blind people with the putative pachyderm, each describing quite different animals depending on whether they’re at trunk, flank or tail. If 5G is that elephant, then operators and suppliers will see multiple sources of revenue while having just the one mouth to feed: If those use cases need very different networks, the benefits will look less elephantine.

The industry expects new services fall into three camps: enhanced mobile broadband (eMBB), ultra-reliable and low-latency communications (URLLC), and massive machine-type communications (mMTC). Each class makes different demands of bandwidth, latency, and intelligence.

5G is designed to handle this mix of services better than LTE can. 5G’s Radio Access Network (RAN) specification manages all the radio functionality—coding, antenna management, errors and retransmissions, and so on. The RAN connects to the Core Network (CN), which sets up connections, and controls bandwidth management, authentication and other classic network functions. What makes the 5G CN so special is that it can handle multiple different configurations of RAN simultaneously, the so-called ‘multi-access scenario’, selecting those that match the needs of different services without needing separate network functionality. These different sets of functions are called ‘network slices’, and it’s how operators build and target network slices that will define their success.

LTE has a nominally similar basic design with its own Evolved Packet Core (EPC) handling network functions, but lacks 5Gs flexibility both in radio and core sectors. However, 5G’s RAN can interoperate with the EPC, as the CN can with LTE radios. This allows 5G to move from the initial Non Stand Alone (NSA) mode, where it supports and requires LTE radios and infrastructure, through the three-to-five year plan which will see the emergence of pure or Stand Alone (SA) 5G. The lack of this blended interoperability transition hindered the move from 3G to 4G, not least by requiring much larger investments in infrastructure before returns were realised: 5G’s new business cases have somewhat better engineered financials to go with the improvements in technology.

ENHANCED MOBILE BROADBAND

The first new business case looks very familiar: enhanced mobile broadband (eMBB) is faster data to handsets. This is already being deployed—EE has started putting 5G in high-density areas of six UK cities, with a further ten promised for 2019. It is partnering with two handset makers, OnePlus and another to be announced, and
the company says that the major use case is to relieve congestion at venues and areas where 4G is overloaded at peak times, such as major railway stations.

5G’s use of higher frequencies than 4G will necessitate more and smaller cells, the cost structure of which needs a new topology. Instead of most traffic going through cell sites that handle lots of baseband processing (turning data into radio and vice versa), a large macro cell will handle the baseband needs of around twelve sub-cells, which EE calls the ‘baseband hotel’ model, and it simplifies control and management.

**FIXED WIRELESS ACCESS**

Another new business model that builds on the old is fixed wireless access (FWA). Already quite well advanced, with LTE links providing cable/DSL speeds to businesses and homes, the biggest upside for 5G is its new radio bands, especially in the higher, millimetre-wave 28GHz and upward spectrum. One company that’s already building out 5G FWA is **CBNL**, a Cambridge UK-based manufacturer that has pre-5G systems with hundreds of operators in more than 50 countries. It considers the fibre-like speeds achievable match well with the halo effect of 4G’s mobile broadband becoming widely accepted. With fixed installations, there’s a lot of flexibility about antenna size and power usage, which can push the usable range of millimetre wave links to kilometers.

There may be a natural end point in the speed battles for broadband delivery. At 1Gbps, home 802.11ax wi-fi and affordable wired Ethernet are saturated and even with multiple independent HD video streams there’s not much need for more. 5G can deliver that while DSL can’t, and many cable systems have problems; wireless data needs no new cabling to the end point. Switching to gigabit services without having to dig up the street is an appealing option.

**MASSIVE MACHINE-TYPE COMMUNICATIONS**

5G’s IoT-focused massive machine-type communications (mMTC) technologies are inherited wholesale from the latter revisions of LTE. There are two main classes: the low-power, narrowband **NB-IoT** and the medium power, medium bandwidth **LTE-M**. The first is aimed at the classic IoT model of static, embedded sensor and control nodes; the second is geared towards supply chain and more flexible uses. 5G absorbs these standards as they are and adds the new bands for greater capacity and the new core network capabilities to add more custom network slices for different use cases. Future releases of 5G will add novel IoT features, such as direct device-to-device communication, but for now it’s existing functionality in new wrappings.

5G’s IoT will compete with a whole slew of technologies—**LoRa**, **Ingeunu (formerly OnRamp)**, **Sigfox**, **Telensa**, and others in unlicensed bands. Plus, the **802.11ah** wi-fi standard—a.k.a. HaLow—is due this year.
While each is bullish about its prospects, the market is both small and fragmented with a lack of common standards and off-the-shelf complete networks making deployment risky and expensive.

For example, the UK government’s utility smart meter push has been going since 2013, but is only around a third of the way towards the 53 million target for the 2020 deadline. With a high failure rate and cost overruns, a glum Parliamentary report said it may cost more than the £16bn total expected benefit: its dependence on 2G networks for communication to utilities and the almost-moribund ZigBee for home controllers has made integration with smartphones and home networks very difficult, and left the system dependent on 2G not being phased out.

5G’s big hope in IoT is that it can provide competitive services on the back of infrastructure that’s already in place for other uses, and—unlike older systems like 2G—the network has a very great deal of flexibility. It uses licensed spectrum, which is managed and not susceptible to third-party interference, and inherits cellular levels of authentication and security.

Operators are also building on experiences of how IoT is paid for. Even when an IoT node is used by a consumer, they don’t pay for service as they would for mobile access. Instead, operators, device makers and service providers use a variety of cost- and benefit-sharing revenue models, including Right To Use—where the operator provides access to defined ports, capacities and bands, and then gets paid according to use. Subscription, permanent licence and other mixtures of connectivity-as-a-service plus support are also used as IoT revenue models. Again, 5G’s ability to create new service types on existing infrastructure is seen as advantageous.

ULTRA-RELIABLE AND LOW LATENCY COMMUNICATIONS

Ultra-reliable and low latency communications (URLLC) opens up use cases where safety and life-critical tasks are involved—not the sort of things that sit well with LTE, with its typical latencies of 50ms to several seconds and block error rates before retransmission of one in ten. 5G, by comparison, will be able to achieve sub-1ms latencies and error rates in the one in a billion. Three typical use cases become feasible at these levels.

Telesurgery is in some respects an established procedure, where a specialist surgeon in one hospital can operate on a patient in another, provided there is excellent connectivity between the venues. Sub-millisecond latency is needed to remove lag between the actions of the surgeon and the video they see of what’s happening. That video needs to be very high quality and stereoscopic, and other channels are needed for haptic feedback from instruments.

Providing wireless connectivity extends the range of telesurgery to those patients who are too ill to be moved, who are too far away, or where physical communication between them and the appropriately equipped hospital
is disrupted due to natural or manmade disaster. Mobile surgical units could also provide services for whole populations.

URLLC fits in particularly well where there is good low-latency, high-bandwidth communication to population centres surrounded by a large rural contingent. This models work in India, where fibre links have been laid alongside the rail network, providing telemedical services near stations. Wireless can extend this considerably.

**Autonomous driving** becomes much more efficient with low-latency, high-reliability networking. When cars can cooperate with each other and share information with roadside infrastructure, tasks like automated overtaking, cooperative collision avoidance and high density ‘platooning’—vehicles forming up into road trains for more efficient driving—become possible and desirable. This sort of task needs latencies below 10ms and block error rates in the tens of thousands. That’s not as stringent as telesurgery by any means, but at much higher densities and with a much more dynamic environment.

A final example of URLCC is **factory automation**. This is an already highly automated environment, but mostly via wired networks. Robotic production lines, industrial processes and factory-wide monitoring and power management requires the same level of performance as telesurgery if safety and efficiency are to be maintained, and wireless networks haven’t been able to deliver the required reliability or performance. Once they can, though, the advantages in flexibility, increased reliability due to no cable motion-related breakage, speed of deployment and lowered maintenance costs will make wireless the preferred infrastructure.

Not all new use cases for 5G fall into the three industry-sanctified groups. A good example of a very different business use comes if you look up. **Drones** that fly out of line-of-site of their controllers rely on data networks, but no terrestrial networks have been designed with drone control in mind. Drones can and do use LTE networks, but the radio environment at flight altitude looks very different to that on the ground. Multiple cell sites will have unblocked line-of-site routes to a drone, which will see many more strong interfering signals than at ground level. Also, the drone will fly into and out of ‘sidelobes’—small areas of strong signal created by antenna configurations—which will have a similar effect to a drone in motion as seeing a lakebed through the surface of rain-spattered water.
Those are radio issues, but other problems exist, as recent events have illustrated. Drones have significant security-threatening and disruptive capabilities, but are notoriously hard to identify and shut down.

5G has multiple enhancements to provide explicit support for drone usage, including specific drone identification and authorisation, height and location reporting, interference detection triggered when a configured number of cells is reached, power control enhancements managing interference versus signal ratios, and signaling of flight path information from the drone to the network. Other aspects of the 5G specification that are not explicitly designed for drone support—such as multiple-cell delivery of a composite signal to a single terminal, beam-steered control channels and enhanced inter-cell handovers—also provide a useful set of tools for supporting flying terminals without disrupting ground-based services on the same infrastructure. If high reliability, ultra-low latency links can be added to the mix, then who knows—remote drone hire from home may be plausible, with drone sport or extreme adventuring thrown in.

ONE NETWORK, MANY SERVICES
It isn’t clear how big a business model drone support will be, but the idea is that it becomes possible to provide a variety of network services for novel functions without having to make major changes to physical infrastructure or across too much of the software stack on which the network runs.
Ericsson, which sells a lot of the infrastructure the core 5G network will be built on, says that the best mental model is of a cheese shop that used to sell just cheddar, but now has to offer hundreds of different kinds of cheese. The old core cheese business may not be so important, but with lots of new customers prepared to pay for unique offerings, the whole business remains profitable.

Whether network operators are ready to make that change remains to be seen. There is a long list of technically possible and genuinely useful new ideas in telecommunications that either never happened or died in infancy due to lack of corporate flexibility. With 5G, though, the tools are there if the imagination requires them.
Five industries that will be most affected by 5G

BY ALISON DENISCO RAYOME

The coming availability of 5G mobile networks will mark a major step forward for digitizing society, impacting a number of different industries that will benefit from the promised low latency and high speeds.

“This year is really when we’re going to start to see true 5G being deployed,” said Mark Hung, vice president at Gartner. “You can expect to see the first 5G phones come out in the first half of this year. But more importantly here in the US, we’re going to see both AT&T and Verizon start deploying mobile 5G networks in select cities.”

All of the major telecom operators have now announced 5G strategies, said Christian Renaud, research vice president at 451 Research.

“We’re starting to see people do proof-of-concept deployments in target markets,” typically high-population cities, Renaud said. “We’re definitely not out of the hype, but we are in early deployments.” Telecoms will work with an enterprise or some other organization to utilize something 5G, such as public safety or transportation, that will give them an example of customer value, Renaud said.

It’s still early for 5G-enabled use cases for any organizations, particularly because equipment is not always available, Renaud said.

“5G is evolving,” said Michele Pelino, principal analyst at Forrester Research. However, it is not yet seamless in any way. “It’s going to take years for that to be the case,” Pelino added. In the meantime, we will see more deployments in the context of particular locations and buildings.

“If I’m an enterprise organization and I want to have applications that are 5G-enabled in every site that I have plant operations in, or offices in, that’s going to require something where you have a more sort of seamless capability for things like self-driving cars, to keep driving around in any type of neighborhood, or use cases where you’re outside of sort of the four walls of an infrastructure,” Pelino said. “It’s going to take some time for that.”

The value proposition of 5G networks is to support applications or use cases tied to very high bandwidth requirements or extremely low latency requirements, Pelino said.

Here are the five industries that will be most affected by 5G when rollout is complete.
1. TRANSPORTATION
5G will enable self-driving cars and vehicle-to-vehicle or vehicle-to-infrastructure setups, Pelino said. “Having extremely low latency for those kinds of things is absolutely critical, or else you could have a risk of an accident,” Pelino said.

The emergence of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) is growing faster than expected, Renaud said. “I think that’s a chicken-and-egg situation, where when 5G is there, you’ll see this explosion,” he added. “5G is going to hit its stride and have a decent coverage area at about the same time that all of the automotive OEMs have said they’re going to be release active, advanced driver-assistance systems and a lot more autonomy in the cars. If that 5G infrastructure is there for them to leverage, you’ll get a lot quicker adoption curve for V2I.”

2. MANUFACTURING
Manufacturing 5G use cases are tied to the mission-critical concept of factory automation, or different processes that must happen in extremely tight time frames to ensure that revenue is not lost, Pelino said.

In this industry, 5G will also enable abilities like real-time production inspection and assembly line maintenance, Renaud said.

3. HEALTHCARE
In healthcare, 5G will facilitate remote telesurgery and patient monitoring, Pelino said, giving doctors the ability to provide care from afar. The network could help augmented reality (AR) and virtual reality (VR) applications become more popular in medical workplaces, which could allow for more training of medical professionals, as well as field workers across other industries, she added.

Healthcare has typically been a laggard when it comes to technology deployment, Renaud said. But now, the regulatory environment is improving, and we’ve seen advances in areas like telemedicine that 5G will aid, he added.

4. ENERGY
Oil, gas, electricity, and other critical infrastructure will be better connected once 5G is rolled out, Renaud said.

“Those industries have a lot of infrastructure that they haven’t connected in the past,” Renaud said. “It may be remote, it may be cost-prohibitive to get Ethernet to a substation or a transmission line that’s hundreds of miles away. Those industries have a lot to gain by these technologies.” It also will allow for remote transmission tower monitoring and improved security, he added.
5. SMART CITIES

5G will improve all aspects of smart cities, include transportation, smart buildings, and smart metering, Pelino said. “It’s tied into that incredible low-latency capabilities where you really need to know what’s happening within the infrastructure of a city or of a building immediately,” she added.

Because 5G allows for network slicing, public safety sectors in cities can also use it without fear of competing for bandwidth access, Renaud said. This is particularly important for emergency services, he added.
Five ways professionals will experience 5G, and when

BY JAMES SANDERS

As mobile network operators sprint to deploy 5G in more localities around the world, interest in and hype around the benefits of 5G is accelerating to Autobahn speeds. Although smartphones are already ubiquitous, the ways in which professionals actually use the new technology are likely to vary, with in-place upgrades of devices coming before newer modalities that leverage 5G, such as wearable technologies and self-driving cars.

Here’s a look at five ways that professionals will potentially use 5G-powered technologies, and when.

1. PROXIMITY-TARGETED MARKETING

Proximity-targeted marketing is still a somewhat nascent field, as marketers work out how to leverage the technology. In December 2018, Burger King took aim at longtime competitor McDonald’s by offering Whoppers for a penny—so long as the order was placed on the Burger King app, within 600 feet of a McDonald’s restaurant. The campaign was lauded in marketing circles, although there was little risk of a downside.

Japanese “no brand quality goods” outlet Mujirushi Ryohin—otherwise known as Muji—operates a geofencing-powered rewards program, although it’s not without problems. Muji’s rewards program provided one point for users who browse in stores even without purchasing. One enterprising hacker used hundreds of accounts and 45 computers to accrue 5.62 million points, equivalent to $51,290 USD, by forging GPS data of visits to stores across Japan, Europe, and the US. The same hacker was arrested twice in one month for operating the same GPS spoofing technique against Aeon Mall, accruing $49,100 in points.

5G’s reliance on microcells could provide a secondary means of verification to protect against GPS spoofing, making proximity-targeted marketing more reliable for businesses and resistant to abuse. As long as a 5G signal is available, this would be technically possible to implement, making it one of the first benefits of 5G that can be realized.

2. WI-FI IN CROWDED SPACES

With the use of mmWave frequencies (>24GHz), and the higher number of smaller base stations required to provide connectivity, 5G mobile networks are more adept at servicing mass numbers of devices in relatively constrained areas. Venues such as crowded conferences, where attendees bring phones and often tether other
devices, can make for a very crowded network, with which 5G is designed to cope. These same principles apply
to other circumstances with variable traffic, such as stadiums and large office towers.

Likewise, at CES 2019 Qualcomm’s Sanjeev Athalye told TechRepublic that 5G and Wi-Fi 6 (802.11ax) are
designed to coexist, as “Wi-Fi 6 and the adjacent standards improve the security of wi-fi so that you don’t have
to worry about rogue access points as much as we do today.” Athalye also noted that 5G enables so-called
“unlimited data plans” as reduced cost for operators should allow for more generous data use, “so an end
consumer doesn’t have to think about am I on cellular or am I on wi-fi? Am I consuming my data bucket
or not?”

3. CONSUMER AND MEDICAL WEARABLE IOT DEVICES

Device manufacturers are analyzing the use of 5G in Internet of Things (IoT) devices likely to travel with
people. While smart appliances can utilize wi-fi, a refrigerator does not particularly need 5G. For devices such
as smart watches and home health monitors, lower power requirements of 5G can lead to thinner devices, as
smaller batteries are required to deliver the same performance per watt as LTE-connected devices.

4. AUTONOMOUS CAR COMMUNICATION

Networks of autonomous cars require a device-to-device communication method that can withstand objects
being in transit. mMTC (Massive Machine Type Communications) was standardized to provide this method,
although presently it leverages legacy LTE networks. Future refinement of mMTC is expected in new standards
from 3GPP.

Although mMTC provides a means through which autonomous cars can communicate, a protocol specifying
what data is transmitted to nearby cars is required. The standardization of this would be beyond what 3GPP,
the standards body responsible for defining 5G standards.

Precision operations including self-driving cars will likewise have some reliance on a future 5G standard called
Ultra-Reliable Low Latency Communication (URLLC), which is anticipated to be finalized in 2020.

“URLLC is instrumental to ensure the safe operation of autonomous cars and delivery drones, expect its reach
to be far and wide, touching all industries and vertical markets – everything from remote surgery in healthcare,
remote oil and gas exploration, remote video surveillance and utility monitoring,” said Brightlink CTO Joe
White. “All of these applications need the reliable super-low-latency that URLLC promises and is currently
hard to deliver.”
5. DEVELOPING THE PROFESSIONALS OF TOMORROW

As 5G mobile networks become more widespread, the increase in the amount of data that can be transferred by a given base station can capably supplant traditional wireline home internet services. Per-gigabyte pricing and data caps on plans touted as ‘unlimited’ by mobile network operators are anticipated to be relative non-issues on 5G connections.

With the advent of a mobile network capable of effectively supplanting a wireline internet connection, this can serve to benefit people who rely exclusively on a smartphone for internet connectivity. According to a report from the Brookings Institution, 35 percent of Hispanics and 24 percent of African-Americans “have no other online connection except through their smartphones or other mobile devices,” while the same is true of only 14 percent of whites. The economic effects of this disparity can be observed in education, as the report notes that internet use for homework is lowest among Hispanic and African-American students.

For families without the means to pay for wired and wireless internet access, 5G levels the field in terms of connection quality. In addition to supplemental educational resources for homework, students in distance and online education courses that rely on streaming video instruction will not require a dedicated wired connection to participate.
The expansion of 5G technology is one of the keys to smart city development.

Cities around the globe are adding technology to improve environmental, financial and social aspects of urban life. A city that uses technology in such a way, to improve the lives of its citizens and improve communication between residents and city officials, is known as a ‘smart city’.

5G will serve as the foundation for small-cell networks that will power the next generation of wireless network infrastructure in a city. The connectivity and computing capacity that 5G enables will make smart cities more of a reality, as city officials can adopt new technologies for smart city solutions.

“Over the next decade I think we will see 5G impacting cities around the globe, and that’s because of the deployment cycle for any new wireless technology. It’s about every 10 years that we get a new technology that’s 10 times better than the previous one. And it then takes about seven years to deploy that at country scale, so
we’re going to see 5G be the technology of the 2020s,” said Zygmunt Lozinski, telecom industry technical leader at IBM.

According to Lozinski, 5G will spur a period of the greatest innovation since microprocessors came out in the early 1970s, and cities will see many benefits from it.

**HOW 5G WILL IMPACT CITIES**

Ian Watterson, CSG’s head of Americas and Asia-Pacific, said, “The proliferation of the IoT and the impending development of 5G connectivity will open the floodgates for the first truly smart city. The major impediment to moving the smart city from the theoretical to the practical was the sheer speed and bandwidth to handle the amount of data generated by the IoT and process it in real time. This will be exemplified in everything from public transit to law enforcement.”

The cost savings that 5G will generate will be a huge boon. According to a white paper from Accenture, smart city solutions applied to the management of vehicle traffic and electrical grids alone could produce $160 billion in benefits and savings through reductions in energy usage, traffic congestion and fuel costs. This means that commute times will lessen, public safety will improve and significant smart grid efficiencies will be realized.

“5G has the ability to help cities do more with the same amount of budget,” explained Jefferson Wang, managing director of incentive strategy for Accenture.

For instance, in a smart city with 5G, there are several layers that can be added to something as simple as a smart streetlight. A 5G-connected streetlight with a video camera or gunshot detection sensor will give information to public safety officials so that they can respond faster. Video analytics can be quickly assessed and AI can be added on top of that to make the city a safer place, Wang explained.

**LIFE-CHANGING IMPACTS FROM 5G**

AT&T works with cities on smart city initiatives, launched 5G services in 12 cities in late 2018, and is adding it early this year to Las Vegas, Los Angeles, Nashville, Orlando, San Diego, San Francisco, and San Jose.

“5G will have life-changing impacts, without a doubt,” said Mike Zeto, general manager of smart cities for AT&T. “We’ll have low meter wave 5G zones start to emerge in cities across the country, which will allow for some very impactful use cases to take place, many of which have to do with public safety.”
There are also 5G use cases involving drones that help with public safety. First responders can benefit from low-latency 5G video cameras around a city. A 5G-connected ambulance can move freely through a city by being connected to a network communicating with traffic signals, and can communicate with doctors at the hospital’s trauma center en route, Zeto said.

Watterson said, “Connected communities require a massive network ecosystem for information to flow, be processed and analyzed in only seconds. 5G moves the construction of smart cities from the theoretical to the practical. For example, underpinned by the speed and data flexibility of 5G, cities can completely transform their traffic systems. This is already starting to occur as ride sharing replaces traditional transportation options—a study by MIT found that New York City traffic could be reduced by 75 percent by ride sharing. Smart cities and the algorithms that power them can create new efficiencies throughout all aspects of urban life.”

The addition of 5G makes fully autonomous vehicles a real possibility. When all of the vehicles in a city are level 5 autonomy, which is the highest level possible, then vehicles will be talking to vehicles with no latency. That’s when a utopia of sorts will be created with autonomous vehicles, explained Matt Preyss, product marketing manager of highly automated driving for HERE Technologies.

The advent of 5G means that cities will be able to use artificial intelligence to analyze the massive amounts of data being collected in a city, said Jason Elliott, 5G market development manager for Nokia. The resulting data can be used to automate processes that are currently done manually.

“This is where 5G starts to play a huge role in the future, because as we start to scale from millions to billions of devices, the capability of 5G can create connectivity. We need that architecture of 5G that’s software based, the flexibility with machine learning elements that can collect all that data, analyze it, and then be able to control or automate a lot of the processes that we do today manually. That can be controlling some kind of gate or barrier, it could be controlling the infrastructure of road services, it could be controlling machines that sweep the roads or something like that,” Elliott said.

The end result is that a city can be more efficient and mundane tasks can be automated, leaving more complex tasks to city employees and citizens, he said.

**NOW IS THE TIME TO START INNOVATING**

The consensus is that 5G is an evolution and it’s being rolled out now, with towers and small cell networks being put in place. The first quarter of 2019 will see more 5G rollouts, particularly toward the end of the period, said Mike Murphy, CTO of Nokia.
But while 5G is still in the midst of these early rollouts, there’s no reason that cities can’t start adding smart services by using existing 4G networks, said IBM’s Lozinski.

“One of the things I’ve been trying to get people to understand is that once you have technologies like cloud and mobile devices and 4G, you can start to experiment with these services now. What 5G does is it brings down the cost of them because the sensors become a lot cheaper and because you can have many more of them to support,” Lozinski said. “So 5G allows that technology to scale at low cost, but there’s no reason people should not be starting. Whether it’s cities, whether it’s mobile operators, or whether it’s innovators who have an idea for a service. You should be thinking about doing that now. What 5G gives you is a platform that you can scale on and repeat this in multiple places. But by all means, you should be looking at it now.”
5G planning: Five things CIOs should be doing now

BY MARY SHACKLETT

By the end of this year, both Verizon and AT&T will have launched 5G networks with data communications rates up to 1.5 GBps. “In five years, I believe we will wonder how we lived without it,” said John Stephens, CFO and senior executive vice president of AT&T. “But it will take some time to evolve.”

The evolution of 5G should certainly be of interest to CIOs. Here are five ways they should be planning for 5G now.

1. SETTING NEW BUSINESS AND IT GOALS

5G network bandwidth and speed dwarfs the bandwidth and speed of the communications we have today. This will facilitate a surge in high bandwidth and real-time communications that companies have been anxious to deploy—and it’s going to have an absolute impact on IT strategic plans.

For CIOs, this means proactively meeting with key executives and managers in the business areas of the company.

Potential business application areas that could expand are step-ups in the use of mobile computing, which will have its bandwidth limitations removed. Data downloads could become non-factors, and we’re likely to see Internet of Things and mobile computing devices connected in real time to the network throughout the day. This will continue to facilitate the move from desktop to mobile computing that is already in process.

We are likely to see more real-time video conferencing and use of video as well.

This could spark significant growth in real-time video-based applications, such as telemedicine and telesurgery in healthcare, the use of drone fleets to fly missions in military operations, real-time marketing to consumers who are locationally detected be near a retail store, and the ability of a utility repair person to live-conference with a subject matter expert at the home office if the onsite tech has a question about how to go about a repair.

2. MAKING NETWORK AND INFRASTRUCTURE REVISIONS

Now is the time for CIOs to audit their present network infrastructures and see what upgrades and/or replacements to network hardware, software, and services might be needed to get ready for 5G. Network upgrades
are expensive, so it is advisable to build out a budget plan that phases in systematic upgrades over a multi-year period that can roughly follow the multi-year trajectory of enterprise 5G adoption.

How much will networks change? Networks, and the traffic they carry, could grow exponentially with 5G.

“One 5G arrives on a nationwide basis, there is so much bandwidth available that we will have pretty much unlimited access to data,” Forrester analyst Dan Bieler predicted.

5G will also introduce new network management techniques. One of these is network slicing, which enables IT to partition a single physical network into multiple virtual networks that are dedicated to specific purposes, such as running an enterprise’s IoT.

Network slicing will enable IT to better manage the performance of specific networks and applications. It also facilitates tighter security over these dedicated “mini networks,” since only certain users and applications will be permitted access.

3. PREPARING FOR A DATA AVALANCHE

Ensighten, a marketing security solutions provider, recently conducted a survey of more than 600 company marketing professionals. 62% of respondents said they often felt overwhelmed by the amount of data they have, and 85% said that they were unable to utilize the data fully.

On the IT data management side of the enterprise, an IDC research project sponsored by Seagate revealed that by 2025, six billion mobile users and IoT applications will have at least one data interaction every 18 seconds. IDC is projecting that this will result in more than 90ZB of data in 2025.

CIOs and other IT leaders should be preparing for the 5G data avalanche now. What kind of data will you accept? Are there certain types of data you want to exclude from network access? For the types of data you collect and manage, how will it be stored and accessed? All are action items that should be addressed in IT’s network and data planning.

4. ADOPTING NEW TECHNOLOGIES AND BUSINESS PROCESSES

Enterprise adoption of cloud solutions for data processing and storage is already well established. With 5G, even more momentum will be added to the business case of moving IT to the cloud, because one of the constraining factors for cloud that exists today—bandwidth—will virtually be removed with 5G.
Accelerated moves of mission-critical applications to the cloud will impact IT strategies in the areas of application deployment, support, governance, and security. This will also prompt a need for IT to work closely with cloud vendors that can be entrusted as able stewards of sensitive corporate data and processing.

The bandwidth and data transfer capabilities of 5G are likely to reshape internal business processes and how IT supports them, as well. One area where IT could see increased business interest is in the deployment of augmented reality (AR).

An example of AR is a building inspector who goes out in the field, inspects a building, and can flip on their “smart glasses” to access the schematics of the electrical wiring in the building, even though the wiring is covered up with drywall. How can they see it? Their smart glasses enable them to live-access the electrical schematics drawings that are on file at headquarters.

AR applications are also likely to increase in corporate training. For many years, aircraft companies have used AR in flight simulators that have simulated the cockpit and flight patterns in the training of pilots. Now, AR can be extended to other functions. For instance, Walmart is using AR to teach store employees how to more effectively interact with customers.

To support AR, corporate networks have to be up to the task. Installing 5G is only one step. Other steps in the process are upgrading network hardware, software, services, and strategic plans and working hand in hand with end business users, where existing business processes, and how IT supports them, will also change.

5. BRACING FOR SECURITY THREATS

Along with 5G’s promise comes the reality that more and more IoT devices and systems will be connected through 5G, and data will move through networks much faster. But 5G is still evolving, and many inherent security vulnerabilities are yet to be discovered. In total, these factors create heightened security risks that IT may not be prepared for. This is a strong argument for IT to go slow in the adoption of 5G—and to convince CEOs and corporate boards of the need to do so.
5G points the way to life beyond the smartphone

BY STEVE RANGER

One of the initial selling points for 5G, for consumers at least, will be that it will give them the smartphone experience they’ve always been sold, but never really had.

All that extra bandwidth and lower latency should mean video chats without the stutter, virtual reality and augmented reality without the motion sickness and lag, and apps that can respond based on your location without freezing up.

All of this is excellent news of course and likely to be the first tangible benefit to consumers of the gradual migration to 5G that will be happening over the next few years.

But one issue for 5G smartphones is that while they will offer better quality services they may not offer anything especially new. While businesses will, over time, get access to potentially useful 5G-powered Internet of Things services, for smartphone users there isn’t going to be much of a change. That might be a headache for telecoms companies and smartphone makers who will be hoping that the rollout of 5G will kick off a new upgrade cycle.

Over time then 5G may well push consumers towards alternative and in-development devices instead.

“With 5G acting as the fulcrum, the market is also set to witness the introduction of new device form factors that leverage a host of new and improved technologies, activated by cues taken from the users’ surroundings, applications, or circumstances,” said a report from tech analyst ABI Research.

In particular a two device form factors will be ones that really benefit from 5G: foldable phones and smartglasses.

Both have been around in prototype format for quite some time but during the lifespan of the 5G networks being introduced—the next decade—they will certainly be widely in use.

Foldable phones are going to hit the shops sooner, the first ones later this year. Foldable smartphones will mean a much bigger screen taking up the same amount of room in your pocket or bag. Those bigger screens will lend themselves to video and richer apps—which will require all that 5G bandwidth.
Slightly further down the line are smartglasses. Some vendors are already testing 5G versions of smartglasses; the idea being that 5G will provide the bandwidth and the speedy response (1 millisecond latency compared to 10 milliseconds on a 4G network) which will allow AR and VR to work without the motion sickness.

There have been all sorts of false dawns for smartglasses of course.

“However, vendors will need to ensure that these latest innovations provide a clear purpose to consumers, offering strong reasons for purchase, or else they run the risk of becoming low-volume niche products,” said ABI.

But the combination of smartphone sales levelling off, making smartphone vendors very keen for a new device to sell and 5G technology coming online, could be the conditions required for a breakthrough. A new companion device in the form of smartglasses would help telecoms companies persuade consumers that 5G is something worth paying a premium for, assuming that other challenges (battery life, privacy, and glasshole ick factor).

5G might finally bring the smartphone experience we’ve already wanted, but may pave the way for the devices to replace your phone, too.
Samsung and 5G: Will this time be different?

BY CHO MU-HYUN

Among Samsung’s numerous businesses, probably no other has been plagued more by rumors of an imminent exit than its network business in recent years.

From 2014 to 2016, when Samsung Group—of which Samsung Electronics is the crown jewel—was commencing its biggest restructuring in over a decade, many considered the network business to be at the top of the list to go.

Businesses that had little to do with IT were sold first, such as its defence business in 2014. Samsung sold its printer business to HP for $1.05 billion in 2016. Samsung has also stopped producing cameras, focusing more on image sensors for smartphones and Internet of Things (IoT) applications.

Meanwhile, a report in 2014 claimed that Samsung Electronics was preparing to merge its network business with its IT service affiliate Samsung SDS, to offer it as a total enterprise solution in the mould of Cisco. Samsung strongly denied the claim. Then in 2015, a different report claimed the company was considering selling the business altogether. Samsung, again, strongly denied the report. The rumor surfaced again in 2018 around the time of Mobile World Congress, forcing its network boss to again deny them.

The main reasons behind the exit logic is, firstly, it hasn’t been profitable for years. It’s an accepted fact that it failed to clinch any major clients in 2014 for its 4G LTE equipment. Secondly, the business’ revenue has been relatively small for Samsung; the company boasts over $200 billion in annual revenue and its consumer and semiconductor businesses contribute tens of billions each year, while the network business has never got close.

To affirm that it won’t be exiting its network business anytime soon, the company announced in November last year that it wants 20 percent market share in the network equipment market by 2020. In the business’ traditional year end reshuffle for 2018, there was no major restructuring in other businesses, but the network division has its boss changed from Youngky Kim, who had led it since 2010, to Kyungwhoon Cheun. Samsung said Cheun, who joined the company in 2012, has been heading next-generation technology development and his promotion meant it was strengthening its network business for the 5G era.

It’s quite an ambitious goal for the industry’s No.5 to make—20 percent share equates to becoming second or third place in the industry. But the South Korean tech giant has spent decades on becoming technology independent in wireless networks and likely sees 5G as a golden opportunity to secure its return on investments. There are many opportunities and pitfalls ahead—chief among them is its leverage in smartphones and the Huawei controversy—so will it succeed?
TECHNOLOGY INDEPENDENCE

Despite not being well known compared to other businesses, Samsung’s network division has a history that stretches back decades. In 1977, Samsung formed a joint venture with US-based GTE—which was acquired by Bell Atlantic in 2000 and now is part of Verizon—in South Korea for technology transfers. The business was then combined with Samsung Semiconductors in 1982, before finally merging with Samsung Electronics in 1988. The technology that it offered was rudimentary: the good old fashioned telephone with wires and all.

In 1992, it collaborated with SK Telecom to offer South Korea’s first-generation wireless service that adopted the Advanced Mobile Phone Service (AMPS) developed by Bell Labs. In the same year, South Korea announced that it would set Code Division Multiple Access (CDMA) as its single wireless standard, and started paying royalties to Qualcomm. From this point onwards, the business’ history mirrors that of another business with a similar trajectory: the System LSI business, which makes logic chips and also existed since the beginning of Samsung. Until recently, the South Korean tech giant had long relied on Qualcomm’s modem and processors for its handsets. It was the same for network equipment. As the country and Samsung didn’t have the core technology necessary to build advanced chips and equipment on its own, the resultant reliance on Western companies had long been a matter of shame for the South Korean tech giant, which wanted technology independence.

Samsung commercialised WCDMA in 2003, with an intention of getting into mobile, or wireless, network equipment seriously for the first time as it continued to strongly push its handsets. Like mobile phones, which were dominated by Nokia and Motorola, network equipment was a market controlled by Ericsson with as Nokia the runner-up. In 2006, Samsung developed WiBro, known as Mobile WiMax, with the Electronics and Telecommunications Research Institute as an attempt to gain independence and a foothold in 4G. WiBro, however, was only a minor hit and long-term evolution (LTE) became the accepted standard for 4G networks. Samsung, in essence, didn’t have the technology, market share, capital, or clout with enterprise partners it has today to dictate terms. The failure prompted the South Korean tech giant to drop WiBro and belatedly enter into the 4G LTE equipment market. Samsung became the biggest LTE patent holder in 2015, with the company’s LTE patents being a key point of dispute during its infamous lawsuits against Apple.
THANK YOU, SMARTPHONES

Samsung isn’t the same company it was ten years ago. It is now the world’s largest electronics maker by revenue and is among the top globally in R&D spending. It has many, many LTE related patents. Samsung has gone mostly independent from Qualcomm preferring to use its own processors and modems.

What Samsung has now is an end-to-end portfolio when it comes to 5G, from equipment to smartphones.

Crucially, its dominance in the Android handset market has given it considerable clout and capital when it deals with carriers. The handset and network businesses are a natural mix; the history of Nokia is a strong example.

Before smartphones, or more precisely, Apple, it was an accepted fact that carriers had the upper hand when dealing with handset manufacturers, especially in markets such as the US and South Korea where the telcos controlled distribution. Apple has since become a remarkable exception to that rule.

“Since [the] iPhone was in high demand, it was Apple which dictated terms, from sales to advertisement, when it negotiated with carriers,” said a senior executive of South Korean telco, who declined to be named.

In Korea, the Fair Trade Commission is investigating allegations that Cupertino effectively forced them to advertise iPhones. It is also alleged that stores were also forced to buy phone models for display.

Samsung doesn’t quite enjoy the prestige that its archrival does—the company is rumoured to have paid huge subsidies to carriers to market its phones—but has built a strong relationship with global carriers, especially in the US, thanks to its long hegemony as the largest Android handset manufacturer.

The Galaxy series enjoys strong demand. In July, former network boss Youngky Kim stressed the strong trust it has with carriers in rolling out 5G wireless equipment. The popularity of the Galaxy and Note series is a big part of that trust. Kim probably also had Huawei in mind, when he stressed trust, though he didn’t explicitly name the firm.

Samsung is aiming to be the first to launch a 5G phone following the unveiling of the Galaxy S10 series. Despite its woes at the low to mid-end from competing with Chinese rivals, it is strongly likely that the South Korean tech giant will maintain its lead in the premium market, similar to Apple.
HUAWEI CONTROVERSY: OPPORTUNITY OR NOISE?

Huawei is the 500 pound gorilla in the telecom equipment market. The Chinese tech giant—which also produces smartphones—along with compatriot ZTE to a lesser extent, has shown incredible growth over the past decade.

“In the 90s, Huawei executives visited South Korea, asking for technology transfers from local companies,” a senior South Korean diplomat told ZDNet, who declined to be named due to the sensitivity of the issue. “That seems not so long ago. It’s still difficult to digest how they have grown to be so big in such a short time frame.”

By the second quarter of 2018, Huawei had 29 percent market share in telco equipment, while Ericsson and Nokia controlled 27.6 percent and 25.8 percent respectively, according to market research firm Dell’Oro Group.

ZTE, who was formerly among the top five vendors, was knocked out of that position in the same quarter due to the US blocking it due to the US-China trade war that seems nowhere near over.

Huawei, dubbed “the Pride of China” by the Chinese people, has since then also been involved in the trade spat, as well as other more serious matters. Earlier this week, the US government charged Huawei and its CFO for conspiracy, fraud, obstruction of justice, and IP theft. The controversy is only set to escalate further. The company’s 5G equipment in recent months has so far been banned or limited by the US, Australia, and New Zealand, while the UK’s BT said it will be stripping Huawei from EE’s mobile core. Further bad news for the firm is likely to arise as the US case unfolds.

This seems to be an opening for Samsung to expand its market share. Its chief target market this year will be the US and South Korea, and to a lesser extent, Japan. Samsung is a vendor for US carriers Verizon, AT&T, and Sprint, that also has strong partnerships with KDDI and NEC in Japan.
Image: Huawei’s recent woes maybe an opportunity for Samsung to gain an earlier foothold in developed countries.

However, this doesn’t mean it is open season. Ericsson and Nokia are well established in Europe. Western countries may have banned Huawei, but less developed countries will likely be inclined to hedge their bets with Huawei despite security concerns due to the Chinese company’s cheaper prices.

“They offer the same equipment 30 percent cheaper or more, so it can be hard to resist,” said a senior executive of a South Korean carrier, who declined to be named.

Yet it would be wrong to say Huawei is winning simply because they are cheap. Much like its Chinese rival, Samsung’s key advantage has also been its price-competitiveness. When it comes to 3.5GHz-spectrum band spectrum equipment, some have argued that the Chinese tech giant’s is superior. According to company insiders, Samsung is hoping to change this narrative through offering 28GHz-spectrum equipment, which they plan to roll out later. The South Korean tech giant also said its true 5G standard will be set in December with Release 16.

As the enterprise market moves slower than the consumer one, it remains to be seen how much of an advantage Samsung will gain from Huawei’s legal troubles, if any at all. And it’s not like other vendors such as Ericsson and Nokia are not noticing the raucous either.

Samsung and SK Telecom have developed a 5G SA switchboard prototype with a modular design where quantum security or high-pass filter modules can be added. Samsung and SK Telecom are strong allies in the local telecom market. (Image: SK Telecom)

**REAFFIRMING ITS HOLD IN SOUTH KOREA**

Huawei’s competitiveness and legal troubles have entered into South Korea as well. Late last year, local carriers SK Telecom, KT, and LG Uplus named their preferred bidders in 5G equipment. Despite huge security concerns from the public, LG Uplus included Huawei alongside Ericsson, Nokia, and Samsung in its preferred bidder list. LG Uplus, as the smallest of the three carriers in Korea, needs to find competitiveness somewhere, so the inclusion of Huawei makes sense. Unlike its Western allies, the government has also yet to ban Huawei, though this may change as the US indictments against Huawei move forward.
South Korea has acted as a steady base for Samsung’s network business. The company has a strong partnership with the country’s top wireless carrier SK Telecom, and together they launched a 1G network some twenty years ago. So despite the temptation to choose Huawei’s more price-competitive offering, SK Telecom and runner-up KT have put its partnership with its compatriot over the newcomer for 5G. Of course, the two Korean wireless carriers’ extensive use of Samsung LTE equipment for 4G also played a key role in their selection, whereas LG Uplus used Huawei’s for LTE.

5G won’t be rolled out in a day. Services rolling out this year in March in South Korea will be non-standalone, meaning they will use LTE networks. When standalone services are commercialised next year, Huawei will likely take part in the bid for equipment used for ultra-high spectrum. In its fourth quarter earnings, Samsung said it will expand its equipment supply for the first markets for 5G in South Korea and the United States, thereby “laying the foundation for global growth.”

It seems then, Samsung’s road ahead for 5G wireless equipment will not be all roses, but compared to 10 years ago, this time it has a fighting chance.