MEDITARI

Global Innovation x Local Opportunities

The Future of Connected Experiences

5G Opportunities & Challenges

November 2020

In collaboration with

JOUN TECHNOLOGIES

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1 / Executive Summary

5G is an exciting next generation wireless communications technology that offers the promise of changing how we live, work and even play. In this whitepaper, we look at how this next generation of wireless technology enables new connected experiences by focusing on three aspects of 5G.

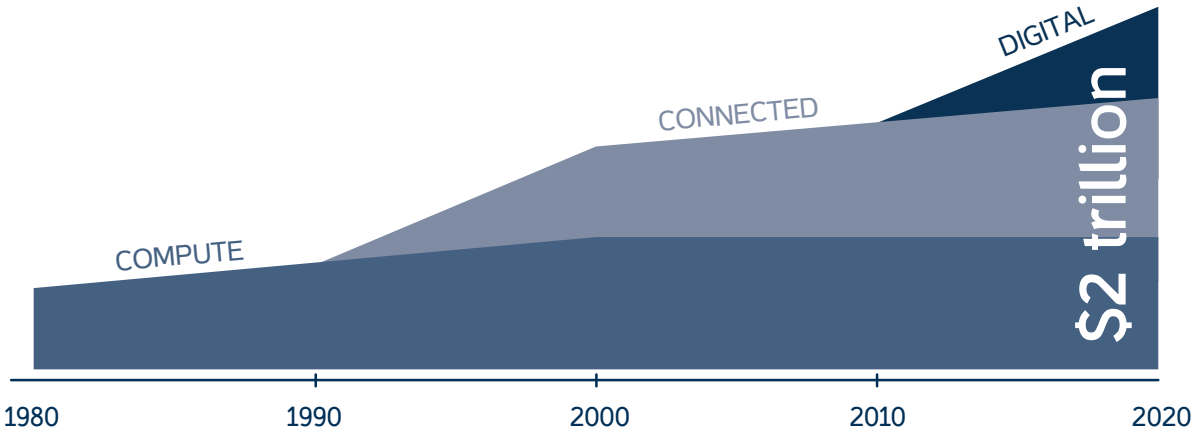
First, we analyze the growth of the electronics market and its relationship to 5G.

Next, we clarify how 5G technology provides an order of magnitude improvement in throughput, latency, and connection density.

And finally, we discuss the implications 5G has across the wireless ecosystem and its key stakeholders; infrastructure vendors, chipsets providers, device OEMs and network operators.

2 / Introduction

Today, the electronics market is over **$2 trillion** in size. Looking at how we got here, we can identify 3 distinct eras.



First, is the Compute era, which started in the 1960s with the advent of mainframe computing and led us to the 1980's where we got the first personal computer. Next came the Connected era, which brought us another iconic device, the smartphone, in the first decade of this millennium and enabled the Digital era where we are today.

When we talk about Digital, it is not simply about replacing paper documents with on-line digital records.

Digital transformation implies fundamentally changing how we do things, from developing automobiles and other mobile devices to impacting business models for products and services and disrupting whole industries.

So what's driving this growth in the Electronics sector?

Automotive

By 2030, 50% of automotive costs will be electronics-based

- Statista -

Number one is the automotive segment and in particular, the push towards autonomous vehicles. In the coming decade , the majority of the cost of a vehicle is projected to be electronics based. This includes everything from the information and entertainment system – called infotainment – to vehicle control and safety functions for driving. When it comes to autonomous vehicle, there are 6 levels of driving autonomy as defined by the Society of Automotive Engineers: Level 0, which is full manual driving all the way to Level 5, which gives us full autonomy.

Today, even the most advanced self-driving car is only at about Level 2. And the effort to go up one level is not linear. So, Level 5 is still a long ways away and to get there will require a lot of effort and fearless innovation.

Smart & Connected

The Global IoT market has grown to $457B in 2020

- GrowthEnabler Analysis -

The second area of growth is in smart, connected devices, which represents about 25% of today's global electronics market.

Up to recently, smart used to mean embedded compute and memory capabilities; today, it implies on-board intelligence, often called edge computing, complemented with cloud connectivity.

Both of these segments – Automotive and Smart, Connected Devices – are driving growth and provide important applications for 5G.

it's all about the G's

	1979	1991	2002	2009	2019
	1G	2G	3G	4G	5G
STANDARDS	AMPS	GSM CDMA	UMTS EV-DO	LTE	5G
FEATURES	Analog Voice	Digital Voice Text	MBB Applications Roaming	Video Steraming	Better plus more !

1G

Since 1979, a new cellular standard gets introduced roughly every 10 years.
It is important to note that it then typically takes around 2 to 3 years after introduction before widespread deployment and economies of scale enable mainstream adoption. Standards normally have a lifecycle of about 20 years, which creates overlap between different generations. For example, analog voice, introduced by the first cellular generation (which wasn't even known as 1G at the time) in the late 1970s, only got shut off completely in the United States around 2008.

2G

2G brought us digital voice, flip phones and texting, which was a bit rough as you had to cycle through the button multiple times to get the letter you needed, so just spelling a word took some time. However predictive technologies kicked in, and the experience improved gradually, until we had full-fledged keyboards, made popular and nearly ubiquitous with Blackberry. We also saw competing standards emerge with GSM used in most parts of the world and CDMA being deployed in the U.S. (notably by Verizon), some areas of China, S. Korea, Central and South America.

3G

3G was the standard that helped spawn the smartphone. We had the first promise of the internet on our phones through MBB or Mobile broadband. We saw the first applications or apps emerge, particularly ones that used the GPS capabilities for location based services like mapping functions. The adoption of voice and text, as well as global roaming capabilities, became much more prevalent.

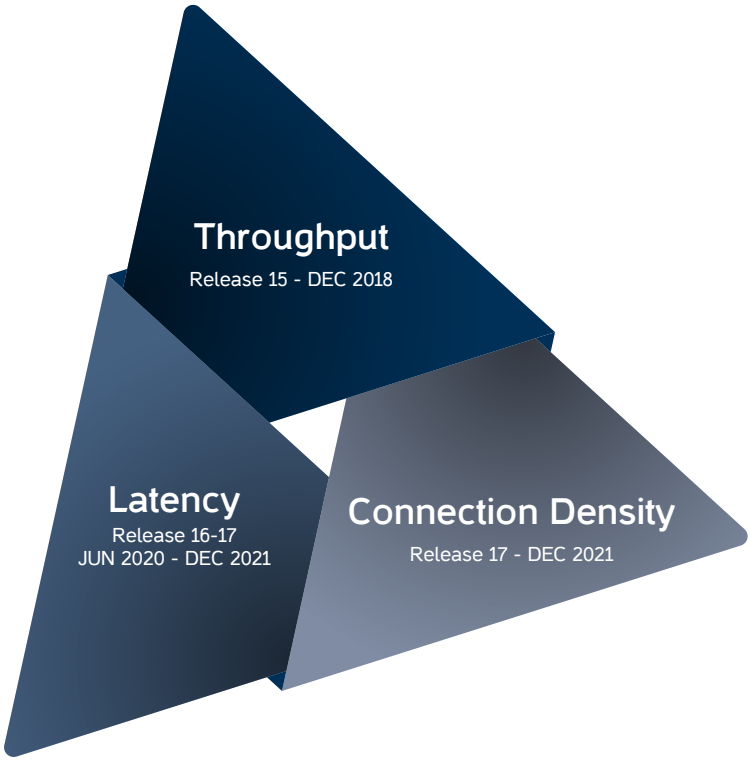
4G

4G came and made the mobile internet promise reality. It multiplied the capabilities of the smartphone, and enabled the video era of cellular, including streaming of on-demand HD content. It also represented a re-unification of the competing standards into a single standard – LTE.

5G

And 5G offers the promise of even better and more features. Like previous generations, it brings more bandwidth improvements. But 5G also represents a truly disruptive generational shift.

3 / 5G – The Technology



The first iteration of the 5G standard – Release 15 – was out in December of 2018. It is important to note that with every cellular generation, features and enhancements are typically rolled out over multiple releases. 5G is no different, with at least 3 releases available or under discussion at this stage.

When looking at the key technology features in 5G, 3 items come to mind: Throughput, Latency and Connection Density. Throughput improvement is a continuation of cellular evolution and is the focus of the first release. Latency - or response time of the network - and Connection Density – how many devices can be connected in a square kilometer – both represent more revolutionary improvements which is the clear indication of a generational shift.

Latency improvements came with Release 16 in June of this year and will be further improved with Release 17 in late 2021, along with connection density enhancements.

Let us take a look at each one of these characteristics.

3.1 / Throughput

The specification for 5G calls for throughput approaching a mind blowing 10 Gigabits/second. This is the theoretical maximum, with early network launches starting at around 1 Gigabit/second under typical situations and going up from there.

This means 5G networks will essentially start off where 4G LTE networks top out, near-Gigabit speeds, and in the same ballpark as fiber connectivity.

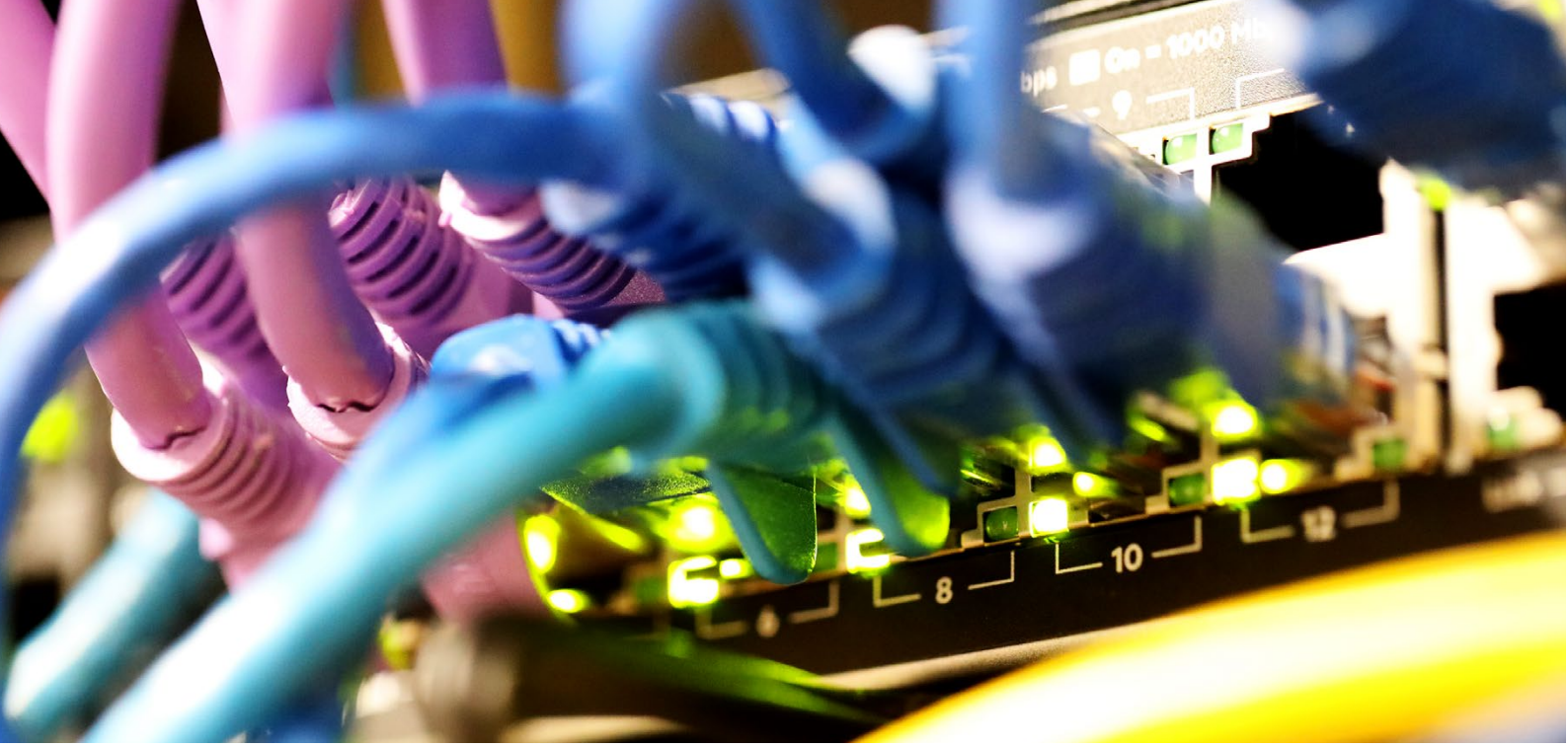
The significance of this is that wireless communication can now replace wired communication in a lot more applications.

Remember when WiFi first got introduced into the personal computer?

While it was great that you no longer had to hook an ethernet cable to the computer to check email or send files, the experience was sometimes not great. If you could find an ethernet port, you still plugged in to speed things up, particularly on large files.

Today, WiFi technology has advanced to the point that the experience for most use cases is the same wireless or wired.

This is what we will start to see with 5G in a couple of key areas today dominated by wired infrastructure: the factory floor and access to the home.



3.1.1 / 5G on the Factory Floor

In electronics manufacturing, you hear a lot today about Industry 4.0 or the 4th Industrial Revolution. Thanks to smartphones, consumer electronics is now ubiquitous. Consumers expect choices and personalization.

Think about buying a smartphone.
You can customize the entire device by choosing size, memory, camera capability, color, and so on. Similarly, look at the number of variables when ordering a laptop or a car. For electronics manufacturers, this means dealing with everything from a lot more part numbers in the manufacturing line to incredible complexities managing the supply chain.

With Industry 4.0, the idea is to use automation, data exchange and artificial intelligence to meet the manufacturing needs of modern electronic products.

Equipment on the floor, particularly advanced robotics, requires and generates a tremendous amount of data, which in the past required a complex - and sometimes limiting - system of cables and connectors.

Being able to free up factory equipment from communication wires provides incredible benefits in flexibility, as well as cost efficiency and maintenance simplicity.

3.1.2 / 5G to the Home

Broadband access into the home is sometimes referred to as the “last mile” and still primarily dominated by copper wires.

Even areas that have done significant fiber rollouts or other high-speed infrastructure upgrades typically stop short of that “last mile.” With 5G, we can now connect a high-speed internet pipe into the house wirelessly, without drilling or cables.

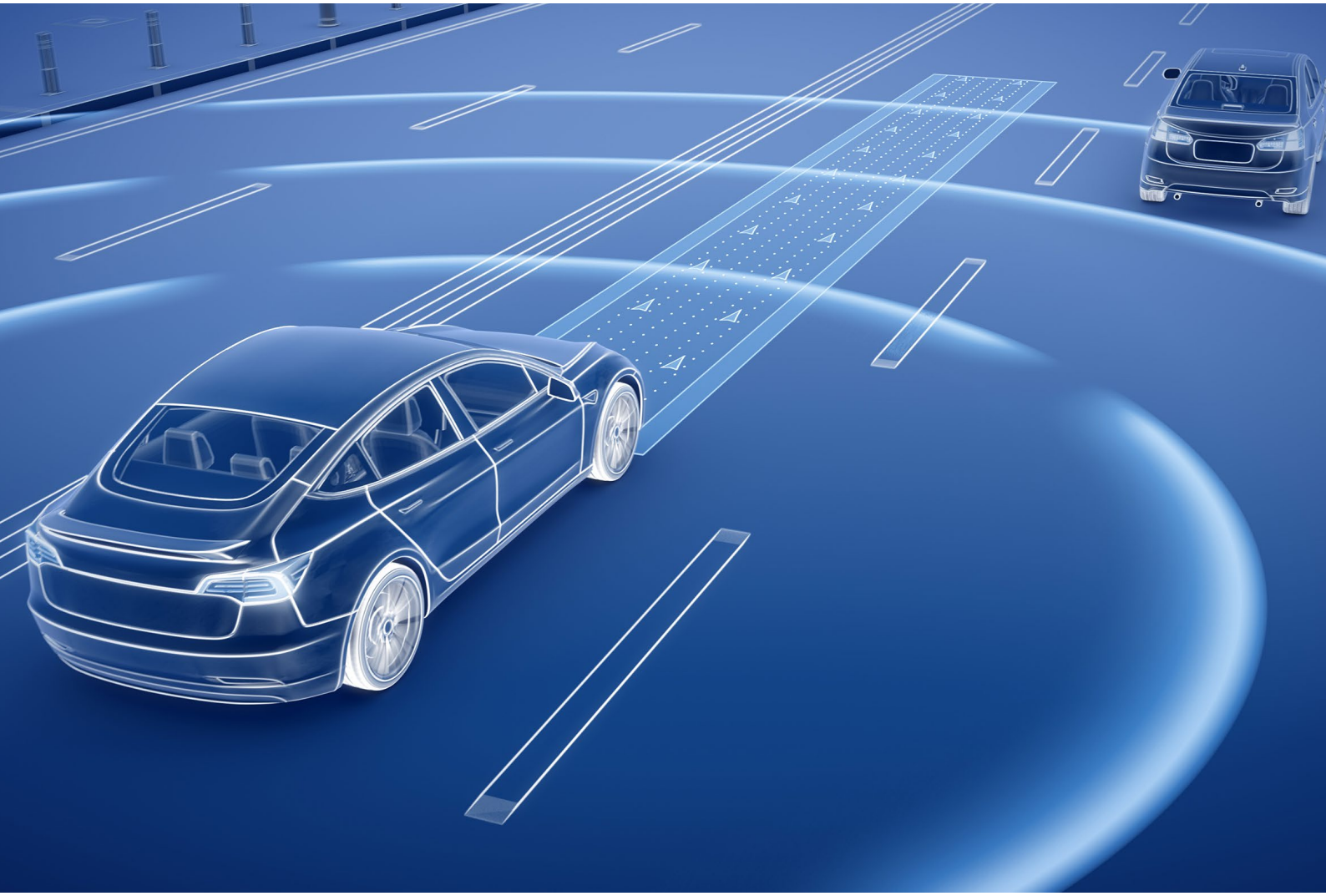
From the inside out, this is now the “first mile.”

We have seen the importance of this consideration lately with COVID-19 restrictions driving us all into Learn From Home (LFH) and Work From Home (WFH) modes, which highlighted the disparity in mobile broadband access around the world.

Even in developed countries, the gap between rural areas and urban downtowns is sometimes substantial and the investments required to deploy fiber connectivity is forbidding, let alone the time it takes to rollout such infrastructure.

3.2 / Latency

If Throughput is speed, then think of Latency as acceleration or lag time, with 5G, this metric will improve by an order of magnitude compared to 4G, approaching 1 millisecond.



This enables real time control for mission critical applications, such as autonomous driving or remote surgery. In order to move self- driving cars up higher in the autonomous level definition – in other words, make them safer – vehicles have to be able to communicate constantly with other vehicles, as well as with different devices such as traffic lights, small cells, and beacons.

This kind of communication is labelled V2X, which means between a vehicle and a variety of other devices. Due to its mission critical nature, latency is much more important than throughput. We might not be sending a lot of data back and forth, but whatever we are sending better get sent fast to avoid accidents or major problems.

3.3 / Connection Density

The third key attribute of 5G is connection density. The standard allows for up to 1 million connected devices in a square kilometer. Like latency, this represents an order of magnitude increase from 4G.

Furthermore, there are also significant improvements in the 5G protocol for power efficiency, which means that you can not only connect a lot more devices, but you can also connect a wider variety of devices.

This includes much smaller devices not possible in the past because of the battery size necessary to meet the power requirements of the 4G connection protocol.

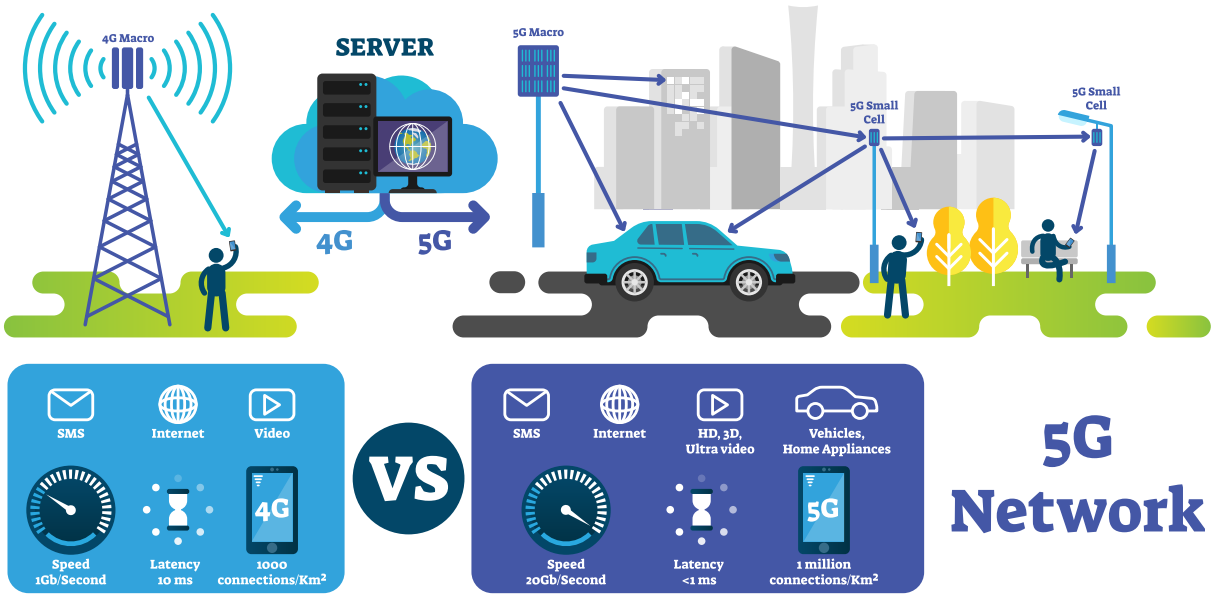
4 / Ecosystem

So 5G technology is exciting and can enable a lot of cool things, but how does a technology become mainstream reality? Again, like with previous cellular generations, it takes an ecosystem to achieve economies of scale.

We are going to look at 4 key elements of the cellular ecosystem and give you a perspective on their opportunities, challenges and trends to keep an eye on.

1 → Infrastructure Vendors
2 → Chipsets Providers
3 → Device Manufacturers
4 → Network Operators

4.1 / Infrastructure Vendors



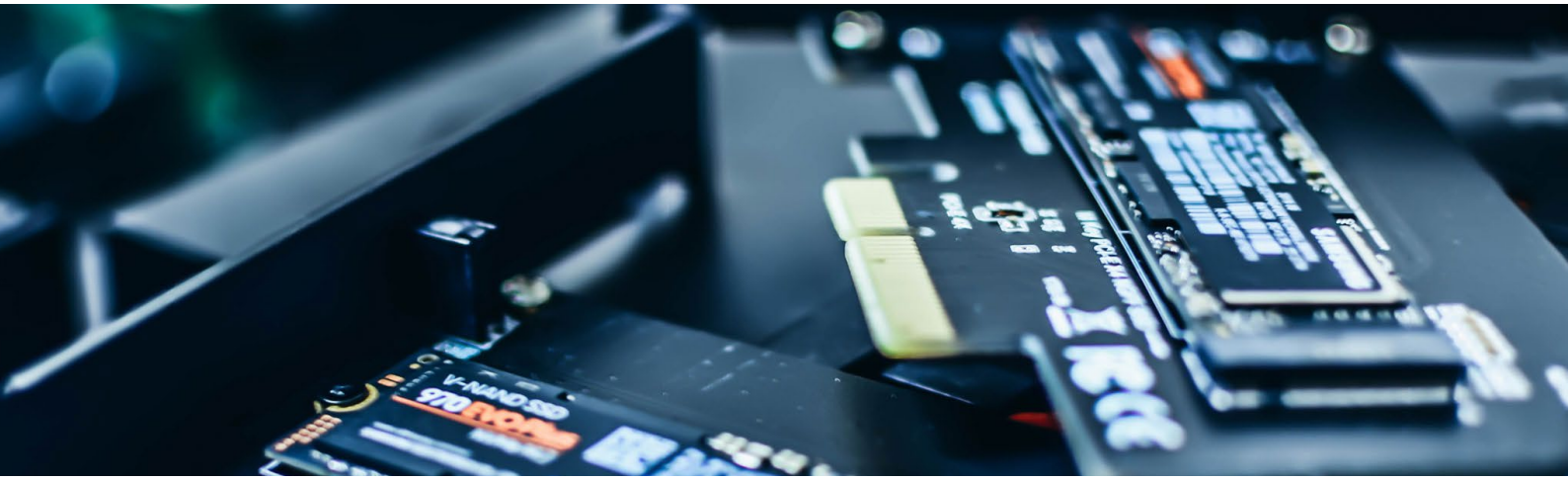
As with every cellular technology generational change, infrastructure vendors typically look forward to incremental network upgrade business. With 5G, the opportunity is multi-dimensional, as vendors also look forward to deploying their 5G gear in new areas such as the wireline replacement that we talked about earlier (factory floors and the "last mile" using small cells). Infrastructure networks are typically designed and optimized from the system level all the way down to custom semiconductor chips.

This optimization is heavily dependent on modelling the expected network traffic that will be processed throughout the system.

Up to and including 4G, mobile traffic was dominated by mobile phones, and specifically smartphones. As a result, infrastructure vendors have had very robust models used to simulate cellular networks . But now, with 5G and the expected diversity of devices from smartphones to automotive vehicles through factory floors and other adjacent sectors, the system optimization process just got a lot more difficult. Many infra vendors are turning to something called Model Based System Engineering (MBSE), a technique that develops hierarchical, behavioral models to help simulate and optimize a system of systems for various use cases. MBSE has been used for decades in other industries like aerospace and automotive.

A key trend to watch here is O-RAN, which stands for Open Radio Access Network; While we mentioned that infrastructure systems have typically been highly customized and proprietary development efforts, O-RAN, with the emphasis on O for open, attempts to put a software virtualization layer on top of standard hardware to provide the same level of infrastructure support.
This means that big data server vendors could now enter the cellular network infrastructure market. So far, a few mobile operators have voiced their support for O-RAN, hoping for the obvious benefit of being able to deploy cheaper systems. Keep an eye on this space to see if O-RAN will be competitive on performance, quality of service and reliability!

4.2 / Chipsets Providers



With growth in consumer electronics comes growth in the semiconductor space market that today is over $500 billion per year. Consumer electronics people like to think they have been driving the semiconductor industry while semiconductor people strongly believe they have been instrumental in making all these consumer electronics innovations possible. The reality is that both need each other, and the relationship is very symbiotic.

Semiconductors are delivering an increasing percentage of the value of consumer electronics systems. Over recent years, it has grown from around 15% to over 20% today and the trend continues upward. For decades now, the semiconductor industry has been driven by Moore's law, named after Intel co-founder and their first CEO, Gordon Moore. Moore stated that the transistor count would double on the same square chip area every 18 months. This helped drive incredible system integration (hence the term System on a Chip - SOC). We are starting to see a slowdown in using pure semiconductor technology scaling to achieve integration. Some elements of 5G chipsets, like processors and memory, continue to push the boundaries of technology nodes, scaling down to 7nm and below. Systems still need functions to be integrated, so instead of doing them at the chip level, semiconductor companies are looking at how to package up multiple chips, built on different technologies, into a single package or System in Package (SiP).

A key trend to watch here is consumer electronic OEMs getting vertically integrated and doing more chip design in house. As the value of semiconductors as a percentage of the overall system climbs and more companies get scale by shipping more electronic systems, the economics of investing in chip design become more compelling. Additionally doing your own chip design also allows for better system differentiation. The top 3 smartphone OEMs all do their own SOC development and you can start to see this trend on the automotive side as well.

4.3 / Device Manufacturers

Device OEMs are excited about the growth of connected experiences, toying with the idea of not only selling smartphones, but smartwatches, health monitoring devices, smart home components - and the list goes on and on.

A big challenge is Big E/Big M; trying to integrate complex electronics (Big E) into a challenging mechanical environment (Big M). Take a smartphone for example, OEMs are trying to put more features and functions like advanced cameras & bigger battery capacity while maintaining device thickness to 7 mm or less. The problem becomes even greater for smaller, connected devices. OEMs are looking at multi-domain solutions that allow for electronic and mechanical design to happen in a collaborative way. In the past, these design functions typically existed in separate silos and communicated only occasionally. The mechanical team would provide an enclosure and tell the electronics team to stay within the outline and hold some interim design reviews together. Today, design teams are talking about collaborative eCAD/mCAD solutions where data can be exchanged real time between electronic and mechanical designers.

A key trend to watch with all these connected devices is the shift from a box that you buy to a service that continues to deliver value over time. You see this emerging in areas like home automation, where a number of companies focus on providing services like intrusion alert or temperature monitoring and the hardware is provided as a mere enabler.

4.4 / Network Operators

For Network Operators, the opportunity lies in connecting more subscribers and devices in more places.

The challenge for operators, in addition to the standard challenge of how fast and where do you roll out 5G, will be mmWave. The shorter distances associated with mmWave will drive more work on figuring out how to deploy small cells into the right places versus blanket coverage from a base station.

Key trends to watch here will be 1) how WiFi 6 will compete or coexist with 5G, particularly on new battlegrounds like the factory floor or inside the home and 2) the opportunity for operators to enable their enterprise clients to have their own private 5G network based on the concept of slicing of licensed spectrum. This would allow manufacturing facilities to control and optimize their end-to-end wireless environment and could also have applications in universities, hospitals, sports venues and entertainment parks.

5 / Conclusion

One positive realization that has come out of this Covid-19 crisis is people are realizing they can work from anywhere if they are connected. 5G has the capability of connecting incredible resources – people, machines, and data – wherever they exist into a single virtual environment.

This level of disruption is what makes 5G a key enabler for digital transformation of businesses. As we outlined, there are several areas of opportunities and challenges for the entire ecosystem.

The businesses that successfully navigate through this complexity will win big. The rest will not and in this digital era, will be gone – and gone fast.

About this Report

Joun Technologies and Meditari established their strategic partnership in 2020, built on a long successful relationship between the founding partners spanning more than a decade
Joun Technologies and Meditari leverage their technology expertise and business networks to bring the most advanced connected digital solutions to companies across the Middle East and Africa region.

Their combined credentials include employers and clients such as:

About us

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We are Meditari, a Digital Advisory Network leveraging the know-how of our global network of partners and advisors to offer our clients trustworthy advice in the Strategy, Technology and Innovation domains across the internet and telecommunications space.

Headquartered in Dubai, United Arab Emirates - we bridge between global innovation and local opportunities through our deep understanding of the technology space, as well as our strong knowledge of the Middle East and Africa markets.

For more info, contact us at hello@meditari.com

JOUN TECHNOLOGIES

Joun Technologies is a management, technical, and educational consulting firm that enables clients to succeed in today's complex, technology driven, global environment.

Headquartered in San Diego, California, our expertise comes from a combination of leading-edge technology know-how, Fortune 100 international executive experience and university teaching and research relationships.

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President, Joun Technologies

Fram Akiki is President and Co-Founder of Joun Technologies, a management, technical and educational consulting group based in California, USA.

As an executive with Siemens, Qualcomm and IBM, Fram has successfully led business units in excess of $ 800 million in revenue and operations groups with over $ 1.5 billion in spend. His 35-year career in the electronics and semiconductor industries has spanned assignments in engineering, product management, sales, marketing and operations. This includes experience in developing and launching a wide range of smart, connected devices, including laptops, tablets, smartphones and IoT devices, including working with a broad set of ecosystem partners on go to market activities. He has been recognized with numerous awards, including the Qualcomm COO Achievement Award and the IBM Division Award for Management Excellence.

Fram holds a B.S. (Highest Honors) in electrical and computer engineering from Clarkson University and a M.S. in electrical engineering and a M.B.A. in International Business from The University of Vermont. He has authored a number of white papers, holds a patent on RFID/Cellular connectivity for the IoT market and is an adjunct instructor at Clarkson University and California State University - San Marcos.

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Ziad Matar is the Founding Partner of Meditari a Digital Advisory Network bridging between Global Innovation and Local Opportunities across the world.

Ziad is a seasoned technology executive with a proven 20+ years track record in global technology companies, where he built and developed business partnerships across the Middle East and Africa and Central Asia region. Following a long career at Ericsson where he held various technology and sales roles, Ziad led the Strategic Business Development activities for Qualcomm in the region where he was responsible for driving commercialization of new technologies such as IoT and 5G. In addition to managing strategic relationships with key stakeholders, including carriers, smartphone vendors, and other technology and digital service providers, he played a leading role in supporting the entrepreneurship and innovation ecosystem in the UAE and across the region through several initiatives at Ericsson and Qualcomm, in partnership with leading local organizations.

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